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THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING. RULES FOR THE GRANTING OF RETIRING ALLOWANCES.

THE aim of the founder in the incorporation of this foundation is clearly expressed in the act of incorporation passed by the Congress of the United States, and approved by the president.

This aim is there stated to be the foundation of an agency to provide retiring allowances for teachers in the universities, colleges and technical schools of the three English-speaking countries of North America, and to serve the cause of higher education by advancing and dignifying the profession of the teacher in these higher institutions of learning. By the terms of the act of incorporation sectarian institutions are excluded from the benefits of the foundation. Consideration of the question of the admission of state institutions has been deferred until some experience

has been had in the actual administration of the trust.

EDUCATIONAL STANDARD.

The term college is used to designate, in the United States, Canada and Newfoundland, institutions varying so widely in entrance requirements, standards of instruction and facilities for work, that for the purposes of this foundation, it is necessary to use, at least for the present, some arbitrary definition of that term. The following definition, now in use under the revised ordinances of the state of New York, will be employed for the purposes of this foundation:

An institution to be ranked as a college, must have at least six professors giving their entire time to college and university work, a course of four full years in liberal arts and sciences, and should require for admission, not less than the usual four years of academic or high school preparation, or its equivalent, in addition to the pre-academic or grammar school studies.

A technical school, to be eligible, must have entrance and graduation requirements equivalent to those of the college, and must offer courses in pure and applied science of equivalent grade.

To be ranked as a college an institution must have a productive endowment of not less than two hundred thousand dollars.

SECTARIAN LIMITATION.

Institutions of learning will be recognized as eligible to the benefits of this foundation, so far as sectarianism is involved, under the following conditions:

1. Universities, colleges and technical schools of requisite academic grade, not owned or controlled by a religious organization, and whose acts of incorporation or charters specifically provide that no denominational or sectarian test shall be applied in the choice of trustees, officers or teachers, nor in the admission of students.

2. In the cases of institutions not owned or controlled by a religious organization, and in which no specific statement concerning denominational tests is made in the charters or acts of incorporation, the trustees of such institutions shall be asked to certify by a resolution to the trustees of The Carnegie Foundation for the Advancement of Teaching that, notwithstanding the lack of specific prohibition in the charter, 'no denominational test is imposed in the choice of trustees, officers or teachers, or in the admission of students, nor are distinctly denominational tenets or doctrines taught to the students.' Upon the passage of such resolution by the governing bodies of such institutions, they may be recognized as entitled to the benefits of The Carnegie Foundation for the Advancement of Teaching, so far as considerations of sectarian control are concerned.

RECOGNITION OF INSTITUTIONS.

Institutions of higher learning, whether universities, colleges or technical schools, whose educational standard is equal to, or higher than, that indicated in the foregoing, and which comply with the conditions regarding sectarian control, may be recognized by the trustees of The Carnegie Foundation for the Advancement of Teaching, as entitled to share in the benefits of the foundation, and a list of such accepted institutions will be announced. This list will be provisional and to it additions will from time to time be made.

To professors in these institutions the benefits of the foundation shall be extended through the institutions themselves, that is to say, once the rules upon which retiring allowances are granted are definitely determined, they shall work automatically, in what might be called normal cases, that is, in cases of old age or long service. Thus if a professor in such an accepted institution has reached the age of x years, or if he has been in the teaching profession for a

period of *y* years, he would receive his allowance as soon as his institution applied for it. In cases outside of the normal age or service conditions, the recommendation of the accepted institution shall be considered by the trustees of The Carnegie Foundation for the Advancement of Teaching, and action taken upon the individual case, and once a grant has been made, payment will be made as in normal cases, through the institution.

No institution will be accepted which is so organized that stockholders may participate in its benefits.

RECOGNITION OF INDIVIDUAL PROFESSORS IN INSTITUTIONS NOT ON THE ACCEPTED LIST.

The trustees realize that there are able and devoted teachers rendering admirable service to education in institutions which, owing to low entrance requirements, or for other reasons, are considered below the academic grade requisite to entitle them to a place on the accepted list of institutions. Individual professors of merit or of distinguished service in such institutions may be granted retiring allowances, but in such cases the trustees will deal with the individual professor. Such allowances can not be granted to professors in institutions deemed to be under denominational control.

CONDITIONS FOR THE GRANTING OF NORMAL RETIRING ALLOWANCES.

1. *Age.*—To be eligible to retirement on the ground of age, a teacher must have reached the age of sixty-five and must have been for fifteen years professor in a higher institution of learning. Whether a professor's connection as a teacher with his institution shall cease at an earlier or later age than sixty-five, is a matter solely within the jurisdiction of the professor himself and the authorities of the institution in which he serves.

2. *Long Service.*—To be eligible for retirement on the ground of length of service, a teacher must have had twenty-five years' service as a professor in a higher institution of learning. It is not necessary that the whole of the service shall have been given in accepted colleges, universities or technical schools.

In no case shall any allowance be paid to a teacher who continues to give the whole or part of his time to the work of teaching, as a member of the instructing staff of a college or technical school.

THE SCALE OF RETIRING ALLOWANCES.

The trustees recognize that a fixed rule limiting the amount of an allowance—such, for instance, as a stated percentage of a professor's salary—can not be adopted without working a serious hardship in many institutions where salaries are low, and under the best conditions must remain low for many years. They have, therefore, adopted a scale under which a teacher who is receiving a low salary is granted a much higher percentage of his salary than is granted to one receiving a higher salary. Thus, for a salary below sixteen hundred dollars a pension of $1,000 or a sum not to exceed ninety per cent. of the active pay, is granted as a retiring allowance. It is believed that this scale is a more just one to men on small salaries. It could scarcely dignify the calling of the teacher to allot to a professor who had served many years at twelve hundred dollars a year fifty per cent. of his pay, although that percentage might be a fairly generous allowance in the case of a professor who had been receiving a pay of five thousand dollars.

RULES FOR THE GRANTING OF NORMAL RETIRING ALLOWANCES.

1. A normal retiring allowance is considered to be one awarded to a professor in an accepted university, college or technical school, on the ground of either age or length

of service. The term professor, as here used, is understood to include presidents, deans, professors, associate professors and assistant professors, in institutions of higher learning.

2. Retiring allowances shall be granted under the following rules, upon the application of the institution with which the professor is connected, and in the application it should be clearly set forth whether the retiring allowance is recommended on the ground of age or service.

3. In reckoning the amount of the retiring allowance the average salary for the last five years of active service shall be considered the active pay.

4. Any person sixty-five years of age, and who has had not less than fifteen years of service as a professor, and who is at the time a professor in an accepted institution, shall be entitled to an annual retiring allowance computed as follows:

(*a*) For an active pay of sixteen hundred dollars or less, an allowance of one thousand dollars, provided no retiring allowance shall exceed ninety per cent. of the active pay.

(*b*) For an active pay greater than sixteen hundred dollars, the retiring allowance shall equal one thousand dollars, increased by fifty dollars for each one hundred dollars of active pay in excess of sixteen hundred dollars.

(*c*) No retiring allowance shall exceed three thousand dollars.

5. Any person who has had a service of twenty-five years as a professor, and who is at the time a professor in an accepted institution, shall be entitled to a retiring allowance computed as follows:

(*a*) For an active pay of sixteen hundred dollars or less, a retiring allowance of eight hundred dollars, provided that no retiring allowance shall exceed eighty per cent. of the active pay.

(*b*) For an active pay greater than sixteen hundred dollars, the retiring allowance shall equal eight hundred dollars, increased by forty dollars for each one hundred dollars of active pay in excess of sixteen hundred dollars.

(*c*) For each additional year of service above twenty-five, the retiring allowance shall be increased by one per cent. of the active pay.

(*d*) No retiring allowance shall exceed three thousand dollars.

6. Any person who has been for ten years the wife of a professor in actual service may receive during her widowhood one half of the allowance to which her husband would have been entitled.

7. In the preceding rules, years of leave of absence are to be counted as years of service, but not exceeding one year in seven. Librarians, registrars, recorders and administrative officers of long tenure, whose salaries may be classed with those of professors and assistant professors, are considered eligible to the benefits of a retiring allowance.

8. Teachers in the professional departments of universities whose principal work is outside the profession of teaching are not included.

9. The benefits of the foundation shall not be available to those whose active service ceased before April 16, 1905, the date of Mr. Carnegie's original letter to the trustees.

10. The Carnegie Foundation for the Advancement of Teaching retains the power to alter these rules in such manner as experience may indicate as desirable for the benefit of the whole body of teachers.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION D—MECHANICAL SCIENCE AND ENGINEERING.

THE meeting of the section for organization was held in the engineering building

of Tulane University. The following officers were elected to serve during the meeting:

Councilor—F. O. Marvin, professor of civil engineering, University of Kansas, Lawrence, Kas.

Member of the General Committee—G. W. Bissell, professor of mechanical engineering, Iowa State College, Ames, Iowa.

Member of the Sectional Committee, 1906 to 1911—J. B. Webb, professor of mathematics, Stevens Institute of Technology, Hoboken, N. J.

The secretary of the section was elected press secretary.

The vice-president of the section, Fred W. MacNair, president, Michigan College of Mines, Houghton, Mich., served as chairman of the section.

Owing to the small number of members in attendance, it was decided to combine the programs of Sections D and B in two joint sessions. These proved to be of general interest and value. The report of the papers offered in Section B will be found on pages 415 to 421 of the issue of SCIENCE for March 16, 1906.

The first paper was read by Fred W. MacNair, president, Michigan College of Mines, Houghton, Mich., and described 'An Experiment on Easterly Deviation beneath the Earth's Surface,' which he had made in the No. 5 shaft of the Tamarack Mine. A detailed report has already been published on page 415 of SCIENCE. It might be added, however, that the experiment of dropping a steel ball from the top of a shaft forty-two hundred feet deep and finding it lodged in the timbers at a depth of only eight hundred feet from the surface, adds but another example to the general experience that bodies which are dropped in a mine-shaft seldom reach the bottom.

A paper by A. S. Langsdorf, professor of electrical engineering, Washington University, St. Louis, Mo., on 'A New Type of Frequency Meter,' was read by the secretary and was published in *The Electrical World*, Vol. 46, page 1029, for December 16, 1905. The device was originally described by the author.[1] It was independently conceived by Mr. J. F. Begole, of the Wagner Electric Manufacturing Company of St. Louis, and has recently been placed on the market. The principle involved in this instrument is based upon the fact that if an alternating (sinusoidal) electromotive force of E volts and frequency $\omega(=2\pi n)$ is impressed upon a condenser of capacity C farads the current will be

$$I = E\,\omega\,C \text{ amperes.}$$

In other words, for a given value of C, the indications of an ammeter will be proportional to the frequency, provided E remains constant, in which case the scale of the ammeter could be graduated to read directly in cycles.

It is of course evident that the assumption of constant electromotive force is not justifiable where commercial circuits are concerned. If the scale of the ammeter mentioned above were graduated to read cycles, a change in line voltage would be recorded as an apparent change in frequency. This difficulty can be overcome, however, if the scale of the ammeter is itself movable and pivoted on a line coaxial with that of the pointer or indicator of the ammeter; if the motion of the scale, due to a change of voltage, is made equal to, and in the same direction as, that of the ammeter needle, there will be no relative motion between the two, and the reading will remain unaltered.

To secure this compensating scale motion, the scale need only be attached to a wound bobbin which is constructed in all respects like that of an ordinary voltmeter, this voltmeter winding being then connected across the line.

In the instrument as built the bobbin to

[1] *Proc. American Association for the Advancement of Science*, Vol. LIII., 1904, p. 380.

which the pointer is fastened, and which carries the condenser current, is mounted either directly above or below the bobbin which carries a graduated scale. Advantage is taken of the fact, suggested by Mr. Begole, that the instrument is a combined voltmeter and frequency-meter.

Carl Kingsley, of the department of physics, University of Chicago, presented a paper which was read by abstract on 'A Critical Analysis of the Methods of Supplying Power to Branch Telephone Exchanges on the Common Battery System.' The five possible methods are considered, and three of these are chosen as most worthy of critical analysis. In each of the three cases the total costs are determined in terms of the distance from the central and the total energy to be supplied at the branch exchanges. Three equations are obtained, each of which contains the three variables, cost, distance and energy. For any particular exchange, the method of supply can be, therefore, readily chosen, which will give the minimum cost of operation. Complete curves have been drawn and a graphical solution of the problem can be obtained by inspection.

D. S. Jacobus, professor of experimental engineering, Stevens Institute, Hoboken, N. J., read and illustrated a paper giving the results of his experiments on 'The Difference in the Coefficient of Discharge of Steam through a Single Circular Orifice in a plate and through a Number of Circular Orifices in the Same Plate.'

The flow of steam through an orifice in a plate was determined and compared with that obtained when six orifices of the same size were placed near each other in the same plate. The flow per orifice was about 14 per cent. greater than with a single orifice. This shows how important it is to consider the conditions which exist on the exhaust side of the orifice. The experiments also showed that the position at which the pressure on the exhaust side of the orifice was measured was an important factor, as this pressure varied considerably when measured at different distances from the orifice plate.

The orifices were $\frac{3}{8}''$ in diameter. The pipe conveying steam to the orifice plate and conducting it away from the same was 2" standard size. The orifice plate was placed in a flange union. The single orifice was at the center of the plate and the six orifices were arranged with one orifice at the center and five midway between the periphery of the center orifice and the inside of the pipe. The pressure on the high-pressure side of the orifice was about 147 pounds per square inch, and on the discharge, or low-pressure, side, about 105 pounds per square inch. The pressure on the discharge side was measured at a considerable distance from the plate in order to avoid a jet action which existed at a point near the plate, which caused the pressure near the plate to be less than at some little distance from the plate.

In a second paper he discussed the subject of 'Priming caused by Poor Circulation in a Boiler,' and described experiments which he had made.

A small vertical tubular boiler of about fifteen rated horse-power was employed in the experiments. This boiler was of the ordinary construction with a water heating surface enclosing a circular grate and with tubes leading directly upward from the combustion space above the fire to the upper tube sheet at the top of the boiler. The steam was taken from the boiler at a point in the outer shell near the top of the boiler. When the boiler was run under normal conditions the steam generated was dry for ordinary rates of combustion, and superheated when the boiler was forced to a high capacity.

In this class of a boiler, the temperature of the flue gases escaping from the tubes near the center of the tube sheet is much higher than that of the gases from the outer tubes, and tests were projected to determine whether there should be a gain in the economy through placing retarders in the center tubes so as to more evenly distribute the work done by the different tubes. In these tests the retarders were so adjusted that the temperature of the escaping gases was made about the same for each of the tubes. After this was done there was an unexpected action through the boiler priming so severely that it was impossible to run it at other than a low capacity. The water level would be constant for a short time and the steam would be dry, when suddenly foam would appear in the gauge glass and water would

be thrown from the boiler along with the steam. On removing the retarders the priming disappeared, and on replacing them it was again present. It therefore appeared that the retarders caused the priming, and it remains to explain how this could be so.

It seems evident that the priming was caused through a lack of proper circulation in the boiler. Without the retarders the tubes near the center of the boiler were hotter than those near the side and caused an upward current of water at the center of the boiler, and a downward current at the sides, and the circulation was a brisk and definite one. With the retarders, however, all the tubes were at the same temperature and there was no tendency to produce a definite circulation so that the water was quiescent for a time, and after storing a certain amount of heat, it would foam up and some of it would be thrown from the boiler.

A paper by Paul C. Nugent, professor of civil engineering, Syracuse University, Syracuse, N. Y., on 'The Dual Degree for Engineering Courses' was read by the secretary.

In the College of Liberal Arts of Syracuse University, the best students are graduated with 'honors' of one of three grades. It has been suggested to adopt the practise in the college of applied science. Its object is to reward merit and to stimulate the student to more strenuous efforts to gain a high standing in his class, and to thus result in graduating a better class of men. The first purpose is in a measure fulfilled. It is doubtful whether the second is accomplished at all.

He reviews the two systems for granting degrees now in use in engineering colleges, namely, granting the engineering degree at the end of a four years' course, and secondly granting the degree of bachelor of science at the end of the undergraduate course, and the full engineering degree on the completion of a year or more of post-graduate work, or two or three years of practical work and on presentation of a thesis. He is strongly in favor of granting the full engineering degree at the end of the four years, and claims that engineering can be taught just as practically and just as professionally as is medicine, and that the engineering graduate is as much entitled to the professional degree as the medical graduate is to the medical degree and the title of 'doctor.'

The author then suggests a fourth plan:

At the end of the regular four-year course, let two degrees be granted, the B.S. being given to those who have passed in all required subjects, but have failed to attain a certain set grade for all the work of the last three years. This plan places the engineering degree on a higher plane than that occupied by the baccalaureate. It is thought that many students who would not care whether they graduated with 'honors' or not would redouble their efforts when it came to graduating as an 'engineer.' Another result would be that almost every engineering graduate would be a man to whom his college could point with confidence and pride. The B.S. men might be permitted to return for a year to obtain the full degree. The dominant thought of all such work should be quality and not so much the teaching of new things as the better teaching and more thorough teaching of the old: it should aim to produce better reasoning powers and general ability in the student, and failing that, the full degree should never be granted.

The paper received considerable discussion and elicited much opposition. Engineering professors, as a rule, seem to be quite well satisfied with the present practise of their respective institutions.

A paper by Mr. Fullerton L. Waldo, of New York, N. Y., was next presented on 'Panama: A Discussion of the Present Conditions and the Prospects.' The paper is true to its title, discusses the various reports of the present conditions, gives examples of these conditions, shows why they are so, and then bears worthy tribute to the character, integrity and engineering ability of the canal commissioner, the late George S. Morison.

Mr. Morison insisted that we must take two years to clean up the mess left by the French, to burn the hovels, to drain the swamps, to petrolize

the breeding places of the mosquito, and to build clean, wholesome houses for the men. He went down there himself and put his fingers into the dry-rot, and found there the seeds of his own mortal illness. Whitewash, either in engineering or in politics, could not fool him. Had he lived, he might have been able to check the tendency to 'hustle' in the scrambling ambition to make dirt fly, simply that the foolable part of our country's population might be deceived by the specious appearance of 'something doing.' All calamity howlers to the contrary notwithstanding, the canal is as sure to be built as that a natural law is certain of fulfilment; and those who to-day busy themselves trying to find arguments against it are going to be ashamed and sorry when the seas are eventually linked by the greatest engineering undertaking in the history of mankind.

Mr. Waldo speaks knowingly and 'makes clear the fundamental soundness of the Panama Canal proposition, and the nature of the temporary difficulties which have hampered the execution of the plans.'

Mr. Worcester R. Warner, of Cleveland, O., who spent a week on the Isthmus in the winter of 1904–5 with the congressional committee, presented a paper on his 'Observations on the Panama Canal,' which was read by the secretary, showing why he is more convinced than ever that the sea-level plan is the only one that our government ought to adopt. He states:

The cause of the failure of the French Company was primarily, and almost wholly, due to maladministration, which is indicated by the ruins of expensive machinery now lying along the route of the canal, more particularly near the Atlantic terminus. Twenty-five years ago, the control of the Chagres River was considered the difficult problem; now it is considered only ten or fifteen per cent. of the problem. Now the great difficulty is the excavation of the material from the Culebra cut. The great wonder of the canal is that so much of it is practically level. From Colon to Gamboa, the fall is only two feet per mile for twenty-eight miles. Ten miles at the Pacific end of the canal compares in grade with the Atlantic end. This leaves about ten miles through the Culebra cut, which can be considered as embodying practically all the difficulties in excavation.

If a sea-level canal is constructed, a dam will be required at Gamboa, where there is splendid foundation for it, and it would make an artificial lake with sufficient capacity to care for the largest freshets whose waters would be drawn off towards the oceans by routes other than the canal bed. Sufficient water would be let into the canal to provide the necessary power for generating electricity for lighting and power purposes. On the other hand, if a lock canal is constructed, a dam 2,000 feet long must be built at Bohio, and possibly another at Gatung, on foundations which are found only at 150 feet or more below sea level, and they can be constructed only with the greatest trouble and at an enormous expense. That a dirt dam at Bohio has been suggested seems hardly credible.

When we consider that the maximum height of the canal at the beginning was less than the height of some of our modern buildings, and that the French Company reduced that height to 150 feet above sea-level, which is practically the height of our nine or ten story buildings, and further, that this height extends only for less than ten miles, Mr. Warner is confident that if the present Congress does not direct a sea-level canal to be built, that the next one will, for our government engineering works in the past have not been conducted on the 'penny-wise and pound-foolish' plan.

One other argument should be mentioned, and that is that without exception the great engineering works of the present generation have proven themselves too small and too limited. This is illustrated by the 'Soo' canal, the first locks of which were discarded years ago and larger ones built, which are soon to be replaced by others still larger. If the Panama Canal is built on the sea-level plan, it can be enlarged without interfering with traffic and without difficulty. On the other hand, if a lock system is used it is limited, and can not be enlarged without being rebuilt.

The vice-presidential address was delivered by Professor Jacobus in the assembly room of Gibson Hall. The subject which he chose was 'Commercial Investigations and Tests in Connection with College Work.' It was concurred in and heartily appreciated by the members of the section and association who had the

pleasure of listening to it. It was published in full in the issue of SCIENCE for January 19, 1906, and will be found on page 92. It was also published in the January issue of the *Stevens Institute Indicator* (Vol. XXIII., p. 7). The author quoted Mr. Walter C. Kerr, in connection with his work as trustee of Cornell University, as being in favor of the plan that a professor shall be thrown upon his own resources and be compelled to work in the practical field one year out of seven. It seems that the author was misinformed as to Mr. Kerr's real meaning, and that Mr. Kerr has called his attention to the matter in a letter which will be found in the April issue of the *Stevens Institute Indicator*. Mr. Kerr explains his ideas at some length, and includes a memorandum on the subject which he made to President Schurman. Eight other letters are included commending the substance of this address and pleading for the more intimate connection of engineering professors with actual practise.

It gives the secretary much pleasure to state that the Society for the Promotion of Engineering Education has decided to meet at Ithaca June 29 to July 3 as an 'affiliated society' of the American Association for the Advancement of Science. It is probable that one or more joint sessions will be held with Section D during the meeting. In view of this, the sectional committee has decided that there shall be a summer meeting of Section D. The members of the association are requested to submit their papers by abstract at as early a day as possible. Papers on the science of engineering education, its problems and its advances, and on municipal ownership from the engineering point of view, are especially requested.

WM. T. MAGRUDER.

OHIO STATE UNIVERSITY,
COLUMBUS, OHIO.

PANAMA: A DISCUSSION OF PRESENT CONDITIONS AND THE PROSPECT.[1]

WHEN a certain prominent member of the engineer corps returned to New York in the fall, after a year's residence at Panama, he declared the working force on the isthmus was badly demoralized on account of the defection of native labor, the resignation of John F. Wallace, the yellow-fever scares, and the excessive humidity, which decreases one's vital energy in the tropics fully fifty per cent. It is now about eight months, he said, since Wallace resigned, and the Shonts Commission, with Stevens as chief engineer, took hold of the work. In May, 1905, the yardage excavated had dropped to 70,000, as compared with 130,000 in April. The figures for June showed a further retrogression. Accordingly, by order of Chief Engineer Stevens, all work was stopped on the canal excavations, and the energies of the force were diverted to sanitative work —the building of houses for the men, cisterns and pipe-lines and reservoirs for drinking-water, sewers to drain a country which has been innocent of sewer-systems and plumbing for four centuries. This is the work which the distinguished engineer and canal commissioner, George S. Morison, said would have to be done in advance of canal excavation, and he allowed two years for it. Governor Magoon has built a reservoir twelve miles from Panama and installed a first-class system of water-works. Two thousand houses of the French have been repaired, new barracks built, and Dr. Gorgas has been doing a magnificent work in eradicating the breeding-places of the mosquito, and purging the whole region of the agglomerated filth of the Spanish occupation.

The necessary action of Chief Engineer

[1] Read at the New Orleans Meeting of the American Association for the Advancement of Science, Tuesday, January 2, 1906.

Stevens in postponing the excavatory work means that a lot of highly-paid specialists —transitmen, levelmen and others—have been practically without occupation, though still, of course, retained on the pay-roll. And of the fact that idleness, in a tropical country, breeds demoralization in a working force, the history of the Panama Canal affords numerous instances. One of the first acts of the new administration was to abolish the quartermaster's department under Capt. E. L. King, and turn over the matter of paying the laborers to the auditing department, who have handled it very badly. Frequently the laborers have been compelled to wait over two pay-days (more than a month), although they live on the credit system, and the Chinese storekeepers refuse to trust them beyond the first pay-day.

With the shut-down of the work on the Culebra cut, a great many of the men from the states were sent home, and consequently skilled artisans have been scarce. Carpenters have been in brisk demand, but it has been difficult to induce a sufficient number to remain upon the isthmus. In constructive work, the great difficulty (as under the Wallace administration) has been to secure supplies. The department of supplies under Paymaster E. C. Tobey, U.S.N., has always been a great stumbling-block to the progress of any work on the isthmus, and it was the inefficiency of this department, as much as anything else, that led to Mr. Wallace's throwing up his hands in despair. However, not all of the trouble has been on the isthmus. The Washington end of the department, under Colonel Edwards, of the Bureau of Insular Affairs of the War Department, is encumbered in its action by much red tape and meaningless routine procedure.

Engineer Stevens has earned for himself, we are told, the title of 'The Sphinx.' (If he has, it seems to us a creditable nickname, in these days when public officers, as a rule, talk too much!) Stevens has discharged scores of men in an attempt to bring about changes for the better. There is much petty jealousy, which vents itself in factional rows. The men sent on by the civil service are far below the standard of the men chosen by selection under the Walker Commission. As a glaring instance might be cited the case of a high engineering official who has been sent to the isthmus at a high salary, after having been discharged by the Walker Commission of 1901–2 for gross inefficiency as a transitman. This criticism applies not only to the specialists and the technical men, but to the mechanics as well. There are 11,000 men on the roster building houses and doing sanitary work for the sanitary department. At the present rate of progress it will take more than a year—perhaps two years—before it will be possible to think of actual canal building. The purchase of a few new steam shovels does not mean very much under the circumstances. Everything drags along at a snail's pace. Mr. Shonts has told the advisory board that the excavation work could not be done at the figures obtained under the Wallace régime (650,000 cubic yards were taken out in the first year at less than fifty cents per yard). The present administration fixes a price of not less than eighty cents per yard.

At the Panama end, the engineer I have been quoting went on to say, work under Resident Engineer Harper is practically at a standstill, and has been very adversely affected by quarantine. At Culebra the engineer parties in the canal prism under Resident Engineer Nichols and the outside work under Ruggles have been accomplishing very little of interest, except some cross-section lines and some borings on the canal line. A gang of men are changing the railroad track from the high, narrow, Belgian rails to the heavier new rails. Prepa-

rations are being made to fill in the lock chamber excavated by the French at Obispo and start in with steam shovels. Track has been laid out from the main line of the Panama Railroad. All idea of double-tracking this road has been abandoned, and instead gangs of men are putting in sidings at all stations. Only fifteen trains a day now run, and the capacity of the single track ought to be three or four times as great as this, with proper handling. Lack of rolling-stock has been a serious drawback. The engineer party at Obispo has been cross-sectioning the tunnel-line to the Atlantic discovered by Engineer Boyd Ehle, but no further advantages have developed, and the net result has been more topography. In general, most of the late surveys have been entirely of a dilatory nature; presumably they have been made in order to keep the large surplus of engineers to some extent employed. Work at the Colon end, in default of proper facilities for unloading vessels, has been of no consequence, and there seems to be a doubt as to the best course to pursue. Division Engineer Moltkey wants to take ships up the canal to a place where there is about thirty feet of water and soft-mud bottom. In the meantime the shipping has to be handled as before.

According to this observer, the most difficult thing to realize on the isthmus is what the 11,000 men are doing; certainly it amounts to very little. Here and there groups of workmen can be seen puttering away, but at the end of a week or a month there is a very inconsiderable result to show for it, and taking the present rate of progress as a measure, it would seem as though the work might go on indefinitely. It is particularly disappointing to Americans to realize that the French must have made a much better showing when excavating 70,000,000 cubic yards and building nearly 1,500 houses and quarters, in spite of great financial embarrassments. My informant is of the opinion that it has yet to be demonstrated that the Anglo-Saxon is better fitted for the task than the Latin, in spite of Chairman Shonts's excuses. It is a notable fact, he says, that men new to the tropics need from six months to a year to comprehend the combined effect of the inertia due to climate, the inefficiency of labor, and the paralysis of energy due to bureaucracy and red tape.

So much, then, for the statements of engineers who have recently returned from the isthmus. A certain allowance must be made for the personal equation. No one man—no group of men—can possibly know all that is to be known about the Panama Canal, and it is a common human tendency to criticize when one, perhaps, does not quite understand. None of us is quite free from this tendency. Let us turn, then, for a moment, from the criticism of labor conditions to a brief statement of actual accomplishment at the isthmus. In any difficult enterprise, when one gets discouraged at what has yet to be done, it is heartening to pause a minute and consider what has, after all and in spite of all, *been done.*

The total yardage excavated on the Panama Canal to date is about eighty million cubic yards. The yardage that directly applies along the canal route as finally determined is about forty-one millions. On the eighty-foot level plan, this means that about 28 per cent. of the big ditch has been dug; on the sixty-foot level plan, about 23 per cent.; on the thirty-foot level plan, about 19 per cent.; on the sea-level plan, about 16 per cent. In the roundest kind of round numbers, this leaves about 185,000,000 yards still to be excavated for a sea-level canal; 140,000,000 for the thirty-foot level; 110,000,000 for the

sixty-foot level. The time required, according to John F. Wallace, is twelve, ten and eight years, respectively. The cost would be: sea-level, $230,475,725; thirty-foot level, $194,213,406; sixty-foot level, $178,013,406. The yardage cost, 54.7 cents, is based on the following figures: Installation of plant, 1.5 cents; mining, 11.2 cents; loading material, 11 cents; transportation to dumps, 11.5 cents; dumps, 4.5 cents; maintenance of track, 8.4 cents; general expense, 6.6 cents. From May 1, 1904, to May 1, 1905, about 650,000 cubic yards were excavated. The United States assumed control May 24, 1904, so these figures practically represent what was accomplished during the first year of American occupation.

The enemies of the canal project are legion, and to the friends of the inter-oceanic waterway—which has now become an accepted fact—the description I have just quoted of the conditions that obtain at Panama seems like a jeremiad of the kind the congressional obstructionists delight in. But he who reads between the lines will not find in the generally trustworthy and unbiased account of the engineer referred to any particular reason to be discouraged about the canal. What it all means is simply this: That on the first of July, 1903, the United States lost the greatest civil engineer our country has ever produced—George Shattuck Morison, a man who spared no effort to find out the facts about isthmian canalization, and then to lay these facts before the people in plain language. Somewhere still in the 'sounding laborhouse vast,' that 'immense and brooding spirit' must be observing, with something of his old, fine indignation, the frenzied haste with which men and supplies have of late been rushed to the isthmus, ere any adequate provision has been made to keep men well, and house them near their work. For instance, a party of engineers, whose work has been of the greatest importance in determining the feasibility of the Gamboa dam—the only alternative for the practically discarded Bohio project—had to wait six weeks to get their transits and levels from the government storehouse. Personal appeal and written protest alike were unavailing. For another party, mosquito-bars were needed. No attention was paid to a requisition, and finally the chief of party stole them.

Mr. Morison, who saw things in a big, broad way, realized that when once the Americans took over the control of the canal zone, they would, with characteristic American impetuosity, be in altogether too much of a hurry to 'make the dirt fly,' adopting the popular slogan. In his numerous addresses delivered before scientific societies—in statements made at hearings before congressional committees—in short, at every public or private opportunity, in season or out of season—Mr. Morison deprecated haste. He insisted that we must take two years to clean up the mess made by the Spaniards and the French—to burn the hovels, to drain the swamps, to petrolize the breeding-places of the mosquito, to build clean, wholesome houses for the men. He went down there himself and put his fingers into the dry-rot, and found there the seeds of his own mortal illness. Whitewash could not fool him, whether it covered the walls of a pesthouse or whether it concealed some mishandling of canal affairs. A great many men, since Mr. Morison died, have paid tribute to his absolute honesty, and his passion for exact statement based on accurate observation. Had Morison lived, he might have been able to check the tendency to 'hustle,' in the scrambling ambition to make dirt fly simply that the foolable part of our country's population might be deceived by a specious appearance of 'some-

thing doing.' All calamity-howlers to the contrary notwithstanding, the canal is as sure to be built as a natural law is certain of fulfilment; and those who to-day busy themselves trying to find arguments against it are going to be ashamed and sorry when the seas are eventually linked by the greatest engineering undertaking in the history of mankind. For a canal which saves nine thousand miles of ocean journey between San Francisco and New Orleans, six thousand miles between Yokohama and New Orleans, two thousand miles between Hong Kong and New Orleans and six thousand miles between Sydney and New Orleans, is an agency in bringing mankind nearer to mankind too vastly important to evade the sight of God and escape the desire of nations. But just now, rather than any statement of cubic yards excavated in August or September or October, one finds the following figures significant:

In June, 1905, there were 62 cases of yellow fever on the isthmus; in July, 42; in August, 27; in September, 6; in October, 3. In August, 1905, with a force of 12,000 men at work, the death-rate was two thirds of one per 1,000, whereas under the French régime, in August, 1882, with a force of 1,900 men, the death-rate was no less than 112 per thousand. These figures will appeal to the citizens of a community whose recent fight against yellow fever has been the admiration of the civilized world and a great object-lesson to uncivilized humanity; an object-lesson in civic self-dependence, public spirit and uncommemorated heroism. A city that can pass through such an ordeal, a city that faces a great crisis as New Orleans faced the yellow-fever epidemic, is the surest guarantee that the nation of which that city is a part will do her duty by civilization, and build, expeditiously and economically, the Roosevelt Canal.

FULLERTON L. WALDO.

THE MOVEMENT IN PRUSSIA FOR THE REORGANIZATION OF THE INSTRUCTION IN MATHEMATICS AND THE NATURAL SCIENCES IN THE SECONDARY SCHOOLS.

FOR over a decade, there has been a noteworthy movement in Prussia aiming at the improvement of instruction in mathematics in the secondary schools.[1] The aim is not an increase of the amount of time given to mathematics, but a reorganization of the subject matter of the mathematical curriculum so as to bring it into closer conformity to the needs of the times, in particular by giving more attention to the applications of mathematics, and by laying less stress in the earlier years on those more abstract phases of the subject which overtax the pupils' powers at that time. The most prominent leader in the movement is Professor Klein, of Göttingen, whose views are most readily accessible to American readers in a recent book collecting various addresses and papers of his on the teaching of mathematics.[2] He is a pronounced advocate of the introduction of the elements of the differential and the integral calculus into the work in mathematics in the secondary schools of Prussia.

This agitation has borne fruit in the new Prussian curricula of 1901, wherein decidedly more stress than previously is laid on concrete beginnings, on graphic methods, on deferring the more abstract phases of the various subjects and on applications throughout to the affairs of practical life

[1] This term is used as indicating the closest American equivalent. The German term is 'higher schools.' Pupils are admitted to the schools at the age of nine, the course of instruction covers nine years, and the normal age of graduation is nineteen or twenty. In mathematics the ground covered is approximately that of our grades, secondary schools and freshman year in college.

[2] F. Klein, 'Uber eine zeitgemässe Umgestaltung des mathematischen Unterrichts an den höheren Schulen,' Leipzig, 1904, pp. ii + 82.

and to the physical sciences. The elements of the calculus were, however, not introduced, even optionally, nor was there an increase in the small amount of analytic geometry to be given in the last year of the course; on the contrary, the option was introduced of proving synthetically instead of analytically such properties of the conic sections as might be taken up. In the curricula of 1901, the ground to be covered in the last two years is stated without specifying the portion to be taken up in each of the years. This would seem to leave it to the discretion of the teacher to determine at what point in the last two years the idea of coordinates should be taken up, but a remark in the general instructions seems to indicate that it is expected that it be taken up in the last year of the course, as formerly.

While questions relative to the teaching of mathematics were thus being vigorously agitated, a no less vigorous agitation was taking place relative to the teaching of the natural sciences. During the last decade the large and influential Association of German Natural Scientists and Physicians has given extended consideration to these questions. At the annual session held in Hamburg in 1901, a joint meeting of the sections for botany, zoology, mineralogy and geology, and anatomy and physiology, over one hundred members present, unanimously adopted a set of nine propositions relative to instruction in biology. These nine propositions soon became generally known as the ' Hamburg Theses,' and read as follows:

1. Biology is an experiential science which indeed goes as far as well-grounded knowledge of nature will at the time allow, but no further. (*Die Biologie ist eine Erfahrungswissenschaft die zwar bis zur jeweiligen Grenze des sicheren Naturerkennens geht, aber dieselbe nicht überschreitet.*) For metaphysical speculations, biology as such has no responsibility and the school no use.

2. *Formally,* instruction in the natural sciences is the necessary complement of the abstract subjects. In particular, biology teaches the art, elsewhere so neglected, of observation of concrete objects subject to continual change in consequence of the processes of life, and, like physics and chemistry, proceeds inductively from observation of properties and processes, to the logical formation of concepts.

3. *As to content,* instruction in natural history has the duty of acquainting the growing youth with the most essential forms of the organic world, to discuss the manifold phenomena of life, to present the relations of organisms to inorganic nature, to each other and to man, and to give a survey of the most important periods of the earth's history. Upon the basis of the biologic knowledge acquired, the structure of the human body and the functions of its organs, together with the chief points of general hygiene, deserve special attention.

4. *Ethically,* biologic instruction awakens respect for the structures of the organic world, an appreciation of the beauty and completeness of nature as a whole, and thus becomes a source of the purest enjoyment, untouched by any of the practical interests of life. At the same time, he who busies himself with the vital phenomena of nature is led to feel the incompleteness of human knowledge, and to recognize his own limitations.

5. Such knowledge of the organic world must be regarded as necessary part of the general culture which the times demand; it is not only useful to the future natural scientist or physician as preparation for his professional study, but is equally important for those graduates of the secondary schools whose future occupation does not directly require study of nature.

The remaining four theses relate more specifically to German conditions, pointing out that under the present curricula biologic study is excluded from the later years of the course, in which years alone the pupil is sufficiently mature to understand what is taught of the processes of life and the influence of environment; demanding that biologic instruction should be given, say two hours weekly, throughout the nine years of the school course; and making some specific proposals whereby it is thought this can be accomplished.

A committee was formed to circulate the theses and the adhesion of about eight hundred scientists was secured. At the session of the association in Cassel in 1903 this committee made a report and proposed that the Hamburg Theses be adopted by the general session of the association. This was done by the adoption of the following motion made by F. Klein, professor of mathematics in the University of Göttingen:

The *Gesellschaft deutscher Naturforscher und Aerzte* unanimously accepts the Hamburg Theses of the committee for the advancement of biologic instruction in the higher schools, with the reservation that the totality of the questions relative to instruction in mathematics and the natural sciences be made the subject of comprehensive discussion at the earliest opportunity.

In consequence of this resolution, the general session of the association at Breslau in 1904, took up the topic, 'Report and Debate on the Instruction in Mathematics and the Natural Sciences in the Higher Schools.'

Preparation was made for the session at Breslau in the discussions of various other societies, such as the *Verein zur Förderung des Unterrichts in der Mathematik und den Naturwissenschaften,* and the *Verein deutscher Ingenieure,* both of which also sent official delegations to the meeting at Breslau.

At this meeting the following reports were presented:

K. FRICKE: 'The Present Situation of Instruction in Mathematics and the Natural Sciences in the Higher Schools.'

F. KLEIN: 'Remarks on Instruction in Mathematics and Physics.'

F. MERKEL: 'Wishes Relative to Instruction in Biology.'

G. LEUBUSCHER: 'Considerations on School Hygiene.'

After discussion of these reports, all the questions involved were referred to a commission constituted as follows:

Messrs. Gutzmer, chairman, representing the section for natural sciences.

Schotten, representing the section of pedagogy.

Leubuscher and Verworn, representing the medical section.

Klein, representing the German Mathematical Association.

Pretzker and Schmid, representing the Society for the Advancement of Instruction in Mathematics and the Natural Sciences.

Poske, representing the German Physical Society.

Fricke and Kraepelin, representing the biological committee.

v. Borries and Duisberg representing the interests of engineers and practical chemists.

The commission has now published a report[3] which is a document of great interest and well worth study beyond the confines of the kingdom with whose educational affairs it primarily concerns itself.

The report consists of four parts: A general report by the chairman, and special reports on instruction in mathematics, in physics and in chemistry (mineralogy), zoology (anthropology), botany and geology.

The commission set up unanimously three governing principles:

I. The commission wishes that instruction in the higher schools be neither one-sidedly linguistico-historical, nor one-sidedly mathematico-scientific.

II. The commission recognizes mathematics and the natural sciences as of equal culture value with the languages and adheres to the principle of specific general culture in the higher schools.

III. The commission declares that the enjoyment in fact of equal rights by the three classes of higher schools is absolutely necessary and wishes its complete realization.

In these three principles the commission

[3] 'Bericht der Unterrichtskommission der Gesellschaft deutscher Naturforscher und Aerzte über ihre bisherige Tätigkeit,' pp. 57, Leipzig, 1905 (F. W. C. Vogel, publisher).

formulated what seems to be the central aim of the entire agitation, to secure recognition, in theory and in fact, of mathematics and the natural sciences as of equal culture value with the linguistic and historical subjects.

It may not be out of place to state in a few words the conditions as they exist in Prussia to-day. It has been stated above that the Prussian secondary or higher schools have a course of nine years to which boys are admitted at the age of nine. This makes the normal age of graduation about nineteen. There are three classes of these institutions, the *Gymnasia*, with Latin and Greek, the *Realgymnasia*, with Latin but no Greek, and the *Oberrealschulen*, with neither Latin nor Greek. Except in small cities, these are always separate institutions, and the choice of the type of education to be given the boy must be made at the age of nine. The curriculum for each type of school is entirely prescribed. A type of institution also exists known as *Reformschule*, which proposes to give the three types of education in the same institution, basing all on the same work during the first three years, and then branching off into one or the other line. The idea has been favorably received, and the number of institutions carrying it out is growing, but this reform is still experimental and the chief problems of instruction relate to the three standard types of institutions to which the commission confined its work exclusively.

The curricula of 1901 distribute the work of the nine years among the different subjects in accordance with the following table, the unit being one hour per week throughout one year.[4]

	Gymnasium.	Realgymnasium.	Oberrealschule.
Religion,	19	19	19
German,	26	28	34
Latin,	68	49	—
Greek,	36	—	—
French,	20	29	47
English,	—	18	25
History,	17	17	18
Geog. (Pol. & Phys.),	9	11	14
Mathematics,	34	42	47
Natural Sciences,	18	29	36
Writing,	4	4	6
Drawing,	8	16	16
Total,	259	262	262

The marked preponderance of the languages will be noted even in the *Oberrealschule*. Classifying geography in the historical group, where the character of the work done would place it, the distribution may be summarized:

Linguistic—Historical,	195	171	157
Mathematics and Nat. Sci.,	52	71	83
Writing and Drawing,	12	20	22
Total,	259	262	262

The commission recognizes the high culture value of the linguistic-historical studies, but asserts an equally high culture value for mathematics and the natural sciences, and in view of the great and growing importance of the second group of subjects in the culture of our times, it denies the necessity that *every* type of liberal education should be preponderatingly linguistic. In this it voices a sentiment that is widespread and deeply felt among the German people. It may be noted that amidst all this there is not the slightest tendency towards an elective system. The diversities of human aptitudes are recognized, and the commission urges that there are types of minds and careers in life whose needs would be met best by a cur-

[4] For more detailed information concerning the German schools see:

Russell, 'German Higher Schools,' New York, 1898 (Longmans, Green & Co.).

Young, 'Teaching of Mathematics in Prussia,' New York, 1900 (Longmans, Green & Co.).

Bolton, 'German Higher Schools,' New York, 1902 (D. Appleton & Co.).

riculum laying more stress on mathematics and the natural sciences than any now in force, but no one seems to have suggested that it might be best to turn over to each boy the task of making his own curriculum. The attitude of mind on which elective systems are fundamentally based is quite foreign to the German temperament.

Passing to the detailed reports, the commission does not ask for an increase in the time devoted to mathematics, but recommends that still further changes be made in the same spirit as those introduced in the official curricula of 1901. While recognizing the formal value of mathematics, the commission believes that some of its more remote and technical phases may be dispensed with and the time thus gained utilized in awakening and developing the ability to regard and interpret mathematically the processes of nature and the occurrences of human relationships. The most important office of the instruction in mathematics is to strengthen the power of space intuition and to train to the habit of functional thinking. Logical training will not suffer if mathematical instruction be given this trend, but will even gain.

A detailed curriculum is proposed embodying the ideas held by the commission. As compared with the curriculum of 1901 now in force, the proposed curriculum cuts down somewhat the more complex calculations and defers to later periods the more abstract topics and methods; on the other hand, it introduces concrete geometry a year earlier (at the age of ten instead of eleven), demands constant use of drawing and measuring, utilizes graphic methods throughout, brings the idea of functionality and of functional variation into the foreground early (at the age of twelve), and utilizes it freely thereafter, introduces the idea of coordinates, of plotting linear expressions and the graphic solution of linear equations at the age of thirteen (four years earlier than in the curriculum of 1901), permits the introduction of the idea of the derivative and of the integral in the next to last year of the course (age seventeen), and lays marked stress on the application of mathematics as widely as possible. A threefold final goal for the mathematical work as brought to a close in the last year is set up:

1. A scientific survey of the organization of the mathematical material treated in the school.

2. A certain power of mathematical perception and its use in the treatment of problems.

3. Finally and above all, insight into the importance of mathematics for the exact cognition of nature.

The reports on the natural sciences call for more time in these subjects even in the classical schools, at least while, as at present, these schools far outnumber the others, and consequently their graduates in all influential walks of life furnish the great majority of those taking the lead. The commission calls for three hours weekly throughout five years in physics, two hours weekly for four years in chemistry and two hours weekly for nine years in the biologic sciences (and geology).

The report on physics sets up three fundamental principles:

1. Physics is not to be taught as a mathematical science but as a natural science.

2. Physics is to be taught so that it may serve as a type of the manner in which knowledge is attained throughout the domain of the experimental sciences.

3. Suitably planned exercises in observation and experimentation by the pupil himself are necessary.

Specimen courses in physics, in chemistry with mineralogy, in zoology with anthropology, in botany and in geology are given. Detailed discussion of these courses and the recommendations that accompany

them would be undertaken more appropriately and carried through more effectively by specialists in these subjects, so that this mention is allowed to suffice for the present report.

The commission also discussed the question of geography, political and physical, and was of opinion that conditions are not yet ripe for the union of geography with the natural sciences, but that, nevertheless, the bases of geography in mathematics and the natural sciences should be taken up in connection with the instruction in these subjects in the higher schools.

It is apparent from the above sketch that a movement of the first magnitude is in progress in Germany for the fuller recognition of the value of mathematics and the natural sciences, on the one hand, and for the reorganization within these subjects of the subject matter taught and the method of instruction, on the other, so as to adapt the work more fully both to needs and capacity of the pupil and to the demands of the times. The writer does not presume to classify the movement or estimate its import in any but his own subject; in mathematics, however, the movement is certainly of international significance. It is one in spirit and aim with the movements for the improvement of the teaching of mathematics in France, in England and in the United States, and while the Prussian problems surely differ in detail from those of other nations, the underlying principles are the same. Our American conditions are vastly different from those which the commission could presuppose, and consequently there could be no thought that the commission's results as such would be available in America, still the consideration of the fundamental principles underlying this thoughtful report of some of Germany's most eminent scientists can not fail to lead the American reader to ponder the same fundamental questions as modified by our environment, and perhaps to stimulate him to evolve some proposal looking towards the accomplishment here of the same end—as sorely needed here as in Germany—the better adaptation of the instruction to the needs and capacity of the pupil and to the spirit and requirements of our twentieth-century civilization.

J. W. A. Young.

The University of Chicago,
November 24, 1905.

SCIENTIFIC BOOKS.

Strandliniens Beliggenhed under Stenalderen I Det Sydøstlige Norge. Af W. C. Brøgger. Med Tysk Resumé, 11 Plancher, 2 Karter og 9 Figurer i Texten. Norges Geologiske Undersøgelse, No. 41. Kristiania, i Kommission Hos H. Aschehoug & Co. 1905.

The first step in the establishment of a relative chronology for prehistoric times was taken by a Dane, C. J. Thomsen, of Copenhagen, seventy years ago. Much of the subsequent progress along this line has been due to Scandinavians. Professor Brøgger's work on the position of raised beaches in southeastern Norway during the stone and bronze ages is of such a character as to indicate that northern investigators are still among the leaders in the kind of research that tends to render our knowledge of prehistoric archeology more accurate.

That the climate of the kitchen-midden period (first stone age in the north) in Denmark was warmer than at present, is now well known. It has also been established by recent investigations in both Denmark and Sweden that the age of the kitchen middens of southern Scandinavia corresponds to the period of maximum postglacial submergence.

A series of curves are plotted on a map so as to pass through isochronal raised beaches. The general course of these curves through southern Norway, southwestern Sweden and all of Denmark is from northwest to southeast. They show the postglacial submergence to have been greatest around Christiania, where the raised beaches marking the maxi-

mum submergence are 70 meters above the present beaches. To the south, it grew less and less, reaching the zero curve at Nissumfjord, Jutland, and Falster in Laaland. The submergence to the north of Christiania also decreased gradually till it reached the vanishing point in the region of Mjosen Lake. This regional submergence is considered as but an interruption in the general elevation of the land.

The synchronism of the curves representing the maximum of submergence is determined through a study of the fauna in the corresponding shell heaps (with *Tapes decussatus*, etc.).

The period between the maximum postglacial submergence (Littorina-Tapes-Sænkning) and the time when the beaches at Christiania were from 45 to 48 meters higher than at present is called the earlier Tapes period. It corresponds to the latter part of the 'Atlantic period' of Blytt, Sernander, *et al.* The period during which the elevation of the beaches dropped from 45 meters to 19–21 meters at Christiania (from 30 meters to 13–15 at the mouth of Christiania fjord) is called the middle Tapes period. The climate of this period was colder than that of the preceding; perhaps colder, also, than during the following period. The last of the Isocardia clays belong to the middle Tapes period.

The later Tapes period corresponds to a beach elevation of from 19 meters to 8 or 10 meters above the present Christiania beaches (13 meters to 4 or 5 meters at the mouth of the fjord). The climate was comparatively mild, the shell heaps being characterized by a number of southern forms no longer to be found in the fjord. The Scrobicularia clay deposits belong to this epoch.

The recent period goes back to a time when the beach line at Christiania was 8 meters higher than it is now. Only after the elevation was complete did the climate become what it now is and the bivalve *Mya arenaria* make its appearance in the waters of Christiania fjord.

The remainder of the work deals with the relation of archeological finds to the various beach levels. The archeological classification corresponds in the main to Müller's classification for Denmark. Müller's time scale, however, is somewhat shorter than Brøgger's.

It was long ago observed that the kitchen middens of northern Denmark are well above the present beach lines. They contain the oldest stone industry to be found in Denmark, viz., flint flakes and paring knives (Skivespalter). But in southern Norway, where flint is scarce, other stone was employed during this early period to produce the so-called Nøstvet industry. Brøgger's researches have established the fact that this old industry occurs at a level corresponding to that of the raised beaches marking the maximum postglacial submergence. It is nowhere found below that level and is, therefore, contemporaneous with the early Tapes period. The Nøstvet industry is, on the other hand, rarely found much above the level of the highest raised beaches. The population must, therefore, have been a coast population, deriving its sustenance largely from the sea.

The axe with pointed pole never occurs at a lower level than that of the beach line marking the close of the early Tapes period. It is a transition form connecting the first northern stone epoch with the second, the latter being the epoch of polished stone axes. The early part of the second stone epoch was characterized by a variety of the axe with pointed pole; the latter part, by a flat-poled axe. During this epoch the habits of the people changed. They were engaged largely in the domestication of animals and in agricultural pursuits. The minimum level of occurrence of this industry is, then, no longer the dominant one. But there is sufficient evidence to prove that, at the close of the second stone epoch, the beaches at Christiania were from 23 to 26 meters above the present beach level.

The third epoch of the stone age is characterized by the thick-poled axe. These are found in Scrobicularia clay deposits as well as in graves. The position of some of these graves is such as to lead to the conclusion that, when they were built, the beach line at Christiania was not more than 13–15 meters higher than it is now.

The bronze age is divided into two epochs. The close of the first corresponds to a former beach elevation of not more than 3.5 meters higher than the present. At the close of the second epoch, the beach line was probably the same as it is now.

In an interesting table, Professor Brøgger gives the results of his attempt to measure the lapse of time since the maximum post-glacial submergence. His basis of reckoning is as follows: (1) The rate of elevation was about the same at the beginning as at the close; (2) the rate during the middle period of elevation was greater than at the beginning or close; (3) the determining of the position of the beach lines at the beginning and end of the bronze age and at the beginning and end of the closing epoch of the stone age, compared with the estimates of archeologists as to the absolute length of the bronze age and the last epoch of stone, gives a standard of measurement for the rate of elevation during the last period of the same. His results are:

(*a*) For the stone age:
First epoch, 4900–3900 B.C., or 1,000 years.
Second epoch, 3900–2400 B.C., or 1,500 years.
Third epoch, 2400–1900 B.C., or 500 years.
(*b*) Bronze age, 1900–500 B.C., or 1,400 years.
(*c*) Iron age, 500 B.C.–1905 A.D., or 2,400 years.
Total of 6,800 years.

According to Sophus Müller,[1] only about 4,900 years have elapsed since the beginning of the stone age in Denmark. He places the duration of the first epoch of the stone age at a minimum of 500 instead of 1,000 years, and the beginning of the bronze age at 1200 B.C. instead of 1900 B.C.

George Grant MacCurdy.
Yale University,
New Haven, Conn.

Catalogue of the Fossil Plants of the Glossopteris Flora in the Department of Geology, British Museum (Natural History). By E. A. Newell Arber. London, 1905. Pp. lxxiv + 255; pl. 8; text f. 51.

This book as is indicated by the subtitle is a 'Monograph of the Permo-Carboniferous Floras of India and the Southern Hemisphere,' and as such will prove not only a boon to the paleobotanist, but of inestimable value to the student of phyto-geography and the evolution of floras. It will be welcome to the geological workers interested in the correlation of those perplexing series of strata so widely distributed in the southern hemisphere and should also be in the hands of those interested in Paleozoic glaciation. Locally the work will also have a large economic value in the hands of operators and prospectors for coal in the regions of which it treats. It embodies the first comprehensive treatment of this flora, and contains, not only a critical summary of previous knowledge heretofore widely scattered through an immense number of publications, but also embraces considerable additions to our knowledge.

The oldest assemblage of land-plants sufficiently representative to be called a flora is that which appeared during the Devonian and became highly complex in the later Devonian and Lower Carboniferous time. This flora was a cosmopolitan one and discloses a remarkably uniform character wherever plant-remains have been found in the rocks of these periods, from about latitude 75° north (Ellesmere Land and Bear Island) southward to Australia and Argentina. This flora included representatives of the following orders: Equisetales, Lycopodiales, Sphenophyllales, Filicales, Cordiatales and Cycadofilicales, the latter possibly including seed-bearing forms (Pteridospermæ). In passing upward into the Upper Carboniferous we find three additional orders, the Cycadales, Ginkgoales and Coniferales; none of these however become of real importance until the dawn of the succeeding Mesozoic era. With the Upper Carboniferous, however, the world-wide uniformity of this ancient flora becomes broken and it is separated into sharply defined northern and southern floras each made up of types belonging to the six dominant Paleozoic orders, which present, nevertheless, an entirely different facies in the two regions. The southern flora, found in strata laid down immediately subsequent to widespread glacial deposits (the Talchir boulder bed of India, the Dwyka con-

[1] *Nordische Altertumskunde.*

glomerate of South Africa, the glacial deposits of New South Wales, Queensland and Tasmania, of the Salt range of India and of Brazil) is usually known as the *Glossopteris* flora, so-called by Neumayr because of the extreme abundance of the undivided fronds of this fern-like plant. This flora is assumed to have been more or less completely isolated from the continental mass of the northern hemisphere, and to have flourished over a great southern continent termed by Suess Gondwanaland from the typical *Glossopteris*-bearing rocks of the lower part of the lacustrine Gondwana system of India.

This *Glossopteris* flora may be roughly characterized and contrasted with that which flourished to the north of it, in the following manner. In the order Equisetales the *Calamites,* which are dominant types in the north are replaced by *Schizoneura* and *Phyllotheca,* the latter dominant and widespread with several species, the former with but few species and not becoming a dominant type until the Mesozoic when it had spread beyond the confines of Gondwanaland. In the order Sphenophyllales one restricted species in India and possibly in South Africa is the sole representative of this common northern type and evidently is an introduced form. The Filicales are characterized by the genera *Glossopteris, Gangamopteris, Neuropteridium* and *Palæovittaria, Gangamopteris* appearing somewhat earlier and replacing the former in Victoria and Brazil.

Neuropteridium is very wide ranging but not abundant, while *Glossopteris* is exceedingly diversified, widespread, and very abundant numerically. The genus *Tæniopteris,* while present, is not a characteristic or an abundant type until the succeeding Mesozoic era, while the various other fern genera which are present are too indefinite or rare to be important elements in a discussion of the flora as a whole. In the order Lycopodiales the southern forms are similar to the northern (*Lepidodendron, Bothrodendron, Lepidophloios, Sigillaria*) and represent a southward migration to South Africa and South America over land connections in those general regions. In the order Cordaitales the important northern type *Cordaites* is replaced by the genus *Nœggerathiopsis* which is widely distributed throughout Gondwanaland, reaching Tonquin and China in the Mesozoic. The Cycadales are few and of a doubtful nature. The Ginkgoales are represented by the indefinite forms referred to *Rhipidopsis* and *Psygmophyllum,* and are also harbingers of the Mesozoic flora. The Coniferales are also few in number and somewhat indefinite in character and may be neglected here. We thus see that of the six dominant Paleozoic orders the Lycopodiales and Sphenophyllales were represented in the Glossopteris flora by only a few migrants. The essentially post-Paleozoic Cycadales, Ginkgoales and Coniferales are alike for both the northern and southern floras, and the chief contrasts are furnished by the fern-like plants and the members of the Equisetales. Land connections evidently became accessible toward the close of the period for we find *Glossopteris* and *Phyllotheca* in the Permian of northern Russia, while other survivors are found in the Mesozoic of Germany, Sweden, China, etc.

The precise age of the *Glossopteris* flora has been a warmly disputed question for over half a century, such eminent paleobotanists as de Zigno, Schimper and Feistmantel claiming it to be Mesozoic (Jurassic), while Clarke, the Oldhams and the Blanfords held that it was of Paleozoic age. Arber's conclusion, one largely accepted in recent years, is that the *Glossopteris*-bearing rocks are homotaxial with those of the Upper Carboniferous and Permian of America and Europe. It was found impossible to distinguish between the Carboniferous and Permian periods so that the epoch as a whole must continue to bear the somewhat indefinite title of Permo-Carboniferous. While it appears that isolation alone could not have produced the remarkable character of the *Glossopteris* flora, Arber refrains from discussing climatic conditions beyond the statement that the widespread glaciation immediately antecedent to the deposition of the earlier *Glossopteris*-bearing sediments probably had a marked influence in this connection. It would have added

greatly to the interest of the work to have had a discussion of the climatic conditions based on the paleobotanical and other evidence at the command of the author.

While largely a matter of speculation, it would seem that the question of an Antarctic continent rather than the more restricted Gondwanaland in lower latitudes might have been considered with profit, although such a discussion might possibly be out of place in a publication of this sort, at any rate, its omission can in no wise be urged as a criticism of this admirable piece of work.

In the matter of nomenclature Arber is cautious, one might say conservative, throughout, and scant space is devoted to those species founded upon fragmentary and indefinite impressions. This 'lumping' process does not seem to be a defect, as many believe it to be in some of the preceding volumes of the British Museum Catalogues, although undoubtedly the actual abundance of species in nature is thereby probably underestimated.

In the genus *Glossopteris* the great variability of size and shape in the same species is emphasized, attention being called to the danger of founding species upon such characters as the thickness or persistence of the midrib, the obtuse or acute apex, or differences in the angles of divergence of the secondary veins, all characters more or less closely correlated with the size and shape of variable fronds. The only characters which seem reasonably safe in systematic work, until internal structures are known, are the average shape of the areoles and the openness or closeness of the secondary veins. In a revision from this viewpoint, confessedly artificial, the author reduces the large number of species of Feistmantel and others, to thirteen forms.

Considerable space is devoted to what little is known of the fructifications of this genus, and many other items of botanical interest are found throughout the work. Mr. Arber is to be congratulated for the way in which he has completed a difficult task, and paleobotanists owe him a debt of gratitude for the thorough way in which he has organized and systematized the literature and nomenclature of this most interesting and heretofore least known flora. Some ninety-two species besides a number of indefinite remains are catalogued. The illustrations are ample and well executed, there being 8 plates and 51 text figures in addition to a map showing the supposed land areas of the Permo-Carboniferous. The systematic portion is preceded by a discussion of the botanical affinities of the flora, its distribution in space, its age and distribution in time, including specific and geologic tables of distribution and correlation, a historical sketch and a history of the collection. The bibliography is complete and the work taken as a whole merits nothing but the warmest praise.

Edward W. Berry.
Maryland Geological Survey,
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Chemie der alicyklischen Verbindungen. Von Ossian Aschan, A. o. Professor an der Universität Helsingfors. Braunschweig, Fr. Vieweg und Sohn. 1905. Pp. xlvi + 1164.

The alicyclic or polymethylene compounds, sometimes also called hexahydrobenzene derivatives, have, up to the present time, received rather stepmotherly treatment from text-book writers. Some of the substances have been described in connection with the aliphatic compounds, while others have been placed in the aromatic section. In short, like most other transition forms, their classification was troublesome and, except in so far as they were of use in connecting the two great families of organic compounds, they were kept as much in the background as possible. To some extent this was unavoidable; it is only in more recent years that it has been possible to prepare well-defined, crystalline derivatives, the study of which could lead to valid conclusions regarding the constitution of the parent substances; indeed, the preparation, in a state of purity, of many of the latter is attended often with very great experimental difficulty, and yet a fairly large number of the alicyclic compounds which occur in nature, such as camphor and various terpenes, are of considerable technical importance.

Professor Aschan's book marks the termination of this state of things, and already one of

the newest and best text-books of organic chemistry has its contents divided into the three sections of aliphatic, alicyclic and aromatic.

The author of a successful monograph must not only be an authority and expert in the subject, but he must make his collection of material as exhaustive as possible, arrange it clearly and systematically and indicate fresh lines of research; if, in addition, he possesses an attractive and concise style, such as is often *not* found in works of this kind published in the German language, the result of his labors is certain to be more than valuable. Professor Aschan's book amply fulfils all these requirements, and therefore the thanks of chemists are due to him for his exertions, and their congratulations on the manner in which he has discharged his task. Some idea of its magnitude will be gained when it is mentioned that more than 5,000 citations are embodied in the 1,200 pages which the book contains. These references to the literature of the subject are brought down to August, 1905. Only an extended use of the work will show how free it may be from error; as yet the reviewer has failed to detect any.

The book should certainly be obtained by all workers in organic chemistry, because they will find it most useful and interesting. Very appropriately, the author has dedicated it to Professor Adolf von Baeyer, in commemoration of his seventieth birthday.

J. BISHOP TINGLE.

SCIENTIFIC JOURNALS AND ARTICLES.

The Museum News of the Brooklyn Institute for April contains articles on 'How Insects are Protected' and 'How to Collect and Preserve Insects,' besides various shorter notes, one of which records the acquisition of a specimen of the rare African water-shrew, *Potamogale*. The collection of shells at the Children's Museum has been rearranged with a view to add to its interest and attractiveness.

The Bulletin of the College of Charleston Museum contains a brief sketch of Dr. Shecut and the origin of the museum, this being one of the papers dealing with the 'History of the Museum.' There seems good reason to hope that the museum may obtain larger and more suitable quarters in the building known as the Thomson Auditorium.

SOCIETIES AND ACADEMIES.

THE AMERICAN MATHEMATICAL SOCIETY.

THE one hundred and twenty-eighth regular meeting of the American Mathematical Society was held at Columbia University on Saturday, April 28, 1906. President W. F. Osgood occupied the chair. Fifty members attended the two sessions. The council announced the election of the following ten persons to membership in the society: Rev. R. D. Carmichael, Hartselle, Ala.; Mr. F. L. Griffin, University of Chicago; Mr. W. R. Longley, University of Chicago; Mr. W. D. MacMillan, University of Chicago; Mr. F. W. Owens, Evanston Academy; Dr. J. J. Quinn, High School, Warren, Pa.; Mr. W. J. Risley, University of Illinois; Dr. R. P. Stephens, Wesleyan University; Mr. J. D. Suter, Iowa State College; Mr. A. M. Wilson, McKinley High School, St. Louis, Mo. Eighteen applications for membership were received. The total membership of the society is now five hundred and thirty.

Professor W. F. Osgood was appointed a member of the editorial committee of the *Transactions,* to succeed Professor E. W. Brown, who retires after seven years' service covering the entire period of existence of that journal.

The by-laws were amended to provide that only members of at least four years' standing shall be permitted to compound life membership.

The following papers were read at the meeting:

G. A. MILLER: 'Groups in which all the operators are contained in a series of subgroups such that any two of them have only identity in common.'

W. H. ROEVER: 'Lines of force illustrated by rotating carriage wheels.'

W. H. ROEVER: 'Systems of lines of force whose differential equations take Bernoulli's form in polar coordinates.'

Virgil Snyder: 'On twisted curves contained in a linear complex.'

G. E. Wahlin: 'The number of classes of binary quadratic forms and ideals.'

R. G. D. Richardson: 'On the fundamental theorem in the reduction of multiple integrals.'

James Pierpont: 'The notion of area of curved surfaces.'

E. R. Hedrick: 'Functions and their derivatives on given assemblages.'

E. R. Hedrick: 'Lipschitz's condition in the case of implicit functions.'

Max Mason: 'A necessary condition for an extremum of a double integral.'

G. A. Bliss: 'An invariant of the calculus of variations corresponding to geodesic curvature.'

Edward Kasner: 'A generalization of conformal representation.'

Edward Kasner: 'Velocity curves in the dynamics of a particle.'

J. W. Young: 'On a generalization of a problem of Tchebychev.'

C. J. Keyser: 'Concerning the bond uniting elements into a space.'

C. N. Haskins: 'Note on the differential invariants of a plane.'

E. C. Colpitts: 'On twisted quintic curves.'

W. C. Breuke: 'On the differentiation of trigonometric series.'

I. C. Rabinovitch: 'The necessary and sufficient kinematic axioms of geometry.'

In the interval between the sessions the members lunched together, and the informal dinner in the evening, attended by some thirty members, afforded another welcome opportunity for conference and renewal of acquaintance.

The thirteenth summer meeting and fifth colloquium of the society will be held at Yale University during the entire week, September 3–8, 1906. The first two days will be devoted to the regular sessions for the presentation of papers. The colloquium, which will open on Wednesday morning, will include the following courses of lectures:

Professor E. H. Moore: 'On the theory of bilinear functional operators.'

Professor Max Mason: 'Selected topics in the theory of boundary value problems of differential equations.'

Professor E. J. Wilczynski: 'Projective differential geometry.'

W. H. Bussey,
Assistant Secretary.

FOLK-LORE MEETINGS IN CALIFORNIA.

The seventh meeting of the California Branch of the American Folk-Lore Society was held in South Hall, University of California, Berkeley, on Tuesday, March 20, 1906, at 8 P.M. Mr. Charles Keeler presided. The minutes of the last meeting were read and approved. The following were elected to membership in the society: Dr. E. K. Putnam, Stanford University, and the Department of Education of Ontario, represented by the Honorable David Boyle, Toronto. Professor Vernon L. Kellogg, of Stanford University, gave an address, illustrated with lantern slides, on 'In Samoa.'

The fourth regular meeting of the Berkeley Folk-Lore Club during 1905–6 was held in the Faculty Club of the University of California on Tuesday evening, April 3. President A. F. Lange presided. On motion a committee consisting of Charles Keeler, A. H. Allen and P. E. Goddard was appointed to report on the feasibility of a special investigation of the folk-lore of Berkeley. Dr. P. E. Goddard then presented a paper entitled 'Some Examples of Tolowa Tales,' which was discussed at length.

A. L. Kroeber,
Secretary.

THE TORREY BOTANICAL CLUB.

The meeting of April 10, 1906, was held at the American Museum of Natural History, with President Rusby presiding. Ten persons were present.

President Rusby, in the absence of the chairman of the field committee, briefly outlined the program for the spring excursions.

The scientific program was an illustrated lecture, by Dr. Henry Kraemer, of the Philadelphia College of Pharmacy, on 'An Experiment in the Growing of Wild Plants, and a Plea for the Preservation of Our Native Woodlands.'

The experiments in the growing of wild plants were carried on in what would usually be considered a very unfavorable situation—namely, a narrow strip of ground about sixty feet long and varying from seventeen to thirty-one inches wide on the northern side of

a city house, where the space between any two houses is not more that eight feet in width, so that it receives very little direct sunlight. Below the thin coating of sod the substratum is composed mostly of debris from the building operations, such as pieces of tin, bricks, slate and pebbles. For two years an attempt was made to grow grass on this strip, but without success.

In 1903, a number of wild plants including diminutive trees, small shrubs and perennial herbaceous plants, in all about a hundred species were added. The plants have been distributed so as to give the best ornamental effect. At intervals of several feet through the middle of the strip the small trees and shrubs and larger herbaceous perennials, as blue cohosh and black snakeroot, are planted. Between these are the smaller plants, the more attractive and those producing the most flowers being near the front, as violets, wild geranium, etc. A few rocks are placed near some of the ferns, columbines, and other plants which seem to prefer a rocky situation. There is a procession of flowers from early spring when the bloodroot, hepatics and spring beauties make their appearance, until fall when the asters and other plants are in bloom. Not only is there a succession of flowers, but the foliage is also of interest and beauty. The ferns and bloodroot are specially interesting when the leaves are unfolding, and in the late fall the yellow leaves of the spice bush and tulip poplar, the red leaves of the maple and dogwood, and also the red berries of the jack-in-the-pulpit and Solomon's seal, the blue berries of the blue cohosh, are very attractive at a time when the flowering season has gone by.

The desirability of preserving individual trees and strips of woodland in the suburbs of cities was considered, and the opinion expressed that if a universal sentiment were created in favor of this, the means would be forthcoming for the purchase and protection of trees and wooded lots. In this connection the statement was made 'that there is no item of taxation which the people of London more cheerfully pay than those for the maintenance of small parks.'

C. STUART GAGER,
Secretary.

DISCUSSION AND CORRESPONDENCE.

C. S. RAFINESQUE ON EVOLUTION.

RECENT discussions in SCIENCE relating to evolution, its nature and terminology, call to mind a very remarkable letter written in 1832 by Rafinesque and published by him in the 'fifth number for the spring of 1833' of his *Atlantic Journal* and 'Friend of Knowledge.'[1] This letter, which in many respects reads so curiously modern, seems to deserve reproduction here. The first part of it, it is true, has been quoted in Call's 'Life and Writings of Rafinesque'[2] but the last half of the letter is not the least interesting part. Asa Gray[3] also quotes a sentence of it, and Darwin[4] refers to two sentences in Rafinesque's 'New Flora of North America,'[5] which show indication of Rafinesque being an evolutionist. The reproduction here is not so much for the purpose of calling attention to the latter fact, but rather to emphasize the essentially modern phraseology employed.

Copied *verbatim, literatim et punctuatim* it is as follows:

124. Principles of the Philosophy of new Genera and new species of Plants and Animals. *Extract of a letter to Dr. J. Torrey of New York dated 1st Dec. 1832.* . . . I shall soon come out with my avowed principles about G.[enera] and Sp.[ecies] partly announced 1814 in my principles of Somiology, and which my experience and researches ever since have confirmed. The truth is that *Species and perhaps Genera also, are forming in organized beings* by gradual deviations of shapes, forms and [p. 164] organs, taking place in the lapse of time. There is a tendency to deviations and mutations through plants and animals of gradual steps at remote irregular periods. This is a part of the great universal law of PERPETUAL MUTABILITY in every thing.

[1] Vol. I., Philadelphia, No. 5, pp. 163–164.

[2] From 'Herbarium Rafinesquianum,' 1833, pp. 11–15.

[3] Silliman's *Amer. Jour. Sci. Art.*, XL., 1841, p. 239.

[4] 'Orig. Species,' 4th ed., 1866, p. xvi.

[5] 1836, pp. 6 and 18.

Thus it is needless to dispute and differ about new G. Sp. and varieties. Every variety is a deviation which becomes a Sp. as soon as it is permanent by reproduction. Deviations in essential organs may thus gradually become N. G. Yet every deviation in form ought to have a peculiar name, it is better to have only a generic and specific name for it than 4 when deemed a variety. It is not impossible to ascertain the primitive Sp. that have produced all the actual; many means exist to ascertain it: history, locality, abundance, etc. This view of the subject will settle botany and zoology in a new way and greatly simplify those sciences. The races, breeds or varieties of men, monkeys, dogs, roses, apples, wheat . . . and almost every other genus, may be reduced to one or a few primitive Sp. yet admit of several actual Sp. names may and will multiply as they do in geography and history by time and changes, but they will be reducible to a better classification by a kind of genealogical order or tables.

My last work on Botany if I live and after publishing all my N. Sp. will be on this, and the reduction of our Flora from 8000 to 1200 or 1500 primitive Sp. with genealogical tables of the gradual deviations having formed one actual Sp. If I can not perform this, give me credit for it, and do it yourself upon the plan that I trace.

C. S. R.

As we know, Rafinesque never worked out the plan he thus had traced, nor was his pathetic appeal to be given credit for it ever entertained. Call (*l. c.*) regards Rafinesque as a Lamarckian rather than a Darwinian, but we are now, perhaps, warranted to ask whether he was not really a de Vriesian. His curious distinction between 'primitive species'* and 'actual species' is more pertinent in this connection than his use of the word 'mutation,' though the coincidence is interesting enough. His 'genealogical tables' also clearly foreshadow the 'phylogenetic tree,' and altogether the whole letter reads singularly prophetic.

I am under obligation to Dr. Theodore Gill for the references to Asa Gray and Darwin.

Leonhard Stejneger.

U. S. National Museum,
Washington, D. C.,
May 3, 1906.

*In another article in the same journal, p. 173, he says that 'almost every *genuine or primitive* species will be found to constitute a peculiar genus.'

THE INFLUENCE OF THE PLASTICITY OF ORGANISMS UPON EVOLUTION.

In their discussions of 'organic selection,' Morgan, Osborn, Baldwin and others have urged the importance of the plastic response of the individual members of a species in guiding the course of its evolution. I do not see that one can doubt the reality of this influence, but as to the extent and exact character of the influence there seems room for discussion.

In the case of a species whose members are highly plastic, responding promptly and extensively, in certain particular ways, to the modifying influences of the environment, those individuals in which similar adaptive characters later appear as congenital variations will have but slight advantage over the ontogenetically adapted, and selection must be comparatively ineffective. The only advantage to the congenitally adapted will be in the fact that in their early life they have to pass through no period of education, and if the ontogenetic adaptation of other individuals be prompt and sufficient, it seems as if the latter would be at comparatively slight disadvantage. A high degree of plasticity hinders evolution by selection, of characters similar to those acquired by plastic response to the environmental influences.

In the case of a species whose members are but slightly plastic, or are slow in their adaptive response, the congenitally adaptive may have a considerable initial advantage. It is doubtful, however, if slight plastic response will be highly effective in securing the survival of the individuals until the species could become congenitally modified in a similar way.

So far, then, as a single set of characters are concerned, we may say that a high degree of plasticity will probably retard evolution as much or more than it will guide, while slight plasticity, allowing only imperfect ontogenetic adaptation, may be ineffective in preserving the species. The guiding effect of ontogenetic responses upon the course of evolution can hardly be both very extensive and intimate (exact).

As has frequently, though not always, been recognized in discussions of organic selection, the guidance of evolution, through plastic modifications of the individual, is not exact. The frequently used illustration of the forced adoption of an arboreal habit by individuals of a monkey-like species, when environmental conditions became unsuitable for their persistence upon the ground, recognizes that this ontogenetic change of habit will not guide to the evolution of an innate tree-climbing instinct. For example, in Conn's use of this illustration, the tree-climbing habit leads to the survival of individuals which show entirely different congenital adaptation, modifications in foot and hand structure. Here a change to a tree-climbing habit has had a general influence, making all adaptation for life in the trees advantageous. The effect is general and the effect upon evolution is general, not preserving congenital adaptations similar to the first ontogenetic adaptation, but preserving entirely different sorts of adaptations. The effect is vague and general. It is, however, no less real.

In a species whose members are slightly plastic, or slowly responsive to modifying influences, innate characters, similar to those ontogenetically acquired, may be evolved, but in a species whose members are highly plastic and rapidly responsive, the adaptive innate characters which may later be produced, will probably be of a type different from that of those ontogenetically acquired. In other words, the greater the plasticity, the less intimate will be its guidance of the course of evolution, for a rapidly acquired and highly developed ontogenetic adaptation is almost as beneficial as an innate adaptation of the same type.

There is another possible influence of plasticity, which is worth considering. There is some paleontological evidence in favor of a belief that there are definite trends in evolution, due to conditions within the organism, rather than to external factors. I have, in this journal, pointed out[1] that the appearance, generation after generation, of the same mutants of *Œnothera lamarckiana*, in numbers far greater than could be explained by purely fortuitous variation, is a further indication of some internal control over variation, making it somewhat determinate, instead of purely indeterminate. Weismann's theory of germinal selection is an ingenious explanation of a possible way in which such trends in evolution may arise and persist. I believe there is evidence that well-defined trends in evolution have existed (paleontological evidence) and do exist (evidence from *Œnothera lamarckiana*). This question could be settled by sufficiently prolonged and sufficiently extensive observations in breeding, to see if variations and mutations do tend to be grouped in particular directions rather than to be equally distributed in all directions from the mean.

If it be true that trends in variation (or in evolution, the same thing) do exist, it suggests an interesting consideration in connection with plasticity. If such trends do exist, it is probable that they will appear in a species, persist for a time and ultimately die out. It is, therefore, possible that the adaptability of the individual members of a species might tide the species over a period of disadvantageous environmental conditions, giving time for some new and advantageous trend to appear. Such an effect is not only conceivable; it seems not unlikely that in numerous instances it may have been important.

MAYNARD M. METCALF.
THE WOMAN'S COLLEGE OF BALTIMORE,
March 6, 1906.

[1] SCIENCE, N. S., Vol. XXI., No. 531, March 3, 1905.

A SIMPLE FORMULA FOR MIXING ANY GRADE OF ALCOHOL DESIRED.

THIS problem of mixing different grades of alcohol recurs almost periodically to the worker in biology, but at sufficiently long intervals for him to forget his method. I do not recall, on the other hand, that I have ever seen any wholly satisfactory rule or formula that was simple, easy to remember, and with which one could, at a glance, mix any desired quantity, or having given a certain volume of any grade of alcohol, that one could with readiness change the whole volume into the required

percentage. Nearly all rules and tables that have come to my notice limit the starting point either to 100 c.c. of the alcohol on hand or to some other quantity which may not be a mathematical factor of the volume that one desires to change. Just one possible exception to this statement has come to my notice. Professor John H. Schaffner in his book ('Laboratory Outlines for General Botany') gives the general pharmaceutical rule which works out very well: 'Take of the grade at hand as many volumes as the number of the per cent. you wish to make, then add to this enough volumes of pure water to make the total number of volumes agree with the number of the per cent. at hand.' This is quite simple and is really a special case of what I have to offer. While recently wrestling with this problem I determined to work it out algebraically, and I believe with success, evolving a formula that is simple and which gives results in an abstract number, or multiplier, with which one can find the amount of water to be added to any given volume of the alcohol at hand, to obtain the per cent. desired. This simple formula is, $v = (P - P') \div P'$ and is translated into words at the end of this article.

To get at the starting point of my formula I took a special case: Make 25 per cent. alcohol from 95 per cent. alcohol. Take 100 c.c. of 95 per cent. alcohol. This contains 95 per cent. of pure alcohol and 5 per cent. of water, or there are 19 parts of pure alcohol and one of water. To make 25 per cent. alcohol from one part of *pure alcohol* requires 3 parts of water. In order then to make 25 per cent. alcohol from the 19 parts of pure alcohol (in the 100 c.c. of 95 per cent. alcohol) we must multiply each part of pure alcohol by 3, excepting the nineteenth part, which must be multiplied by 2, since there is already one part of water, namely the twentieth part present. In figures this gives $18 \times 3 + 1 \times (3 - 1) = 56$ parts of water to be added. But we began with 19 parts (or 95 per cent.) of pure alcohol and 1 part (5 per cent.) of water, so that our total number of parts will be $56 + 19 + 1 = 76$ parts of 25 per cent. alcohol. Proof: $19 \div 76 = 25$ per cent. as required. Or, using per cent., we have 90 per cent. $\times$ 3 + 5 per cent. $\times (3 - 1) + 5$ per cent. $+ 95$ per cent. $= 380$ per cent. $95 \div 380 = 25$ per cent. as required. Now it is quite evident that a similar course of reasoning can with more or less difficulty be applied to any case imaginable. Therefore, let P represent the per cent. of the alcohol on hand, P' the per cent. required, v the multiplier with which to multiply any volume of the alcohol on hand to obtain the volumes of water to be added, y the number of volumes of water to be added to a volume of *pure alcohol* to obtain the per cent. required, z the per cent. of water in the alcohol on hand, and 100 per cent. the volume taken of the alcohol on hand. Then, following our original course of reasoning we have: $(P - z)y + z(y - 1) = v$ 100 per cent. (by definition), or $Py - z = v$ 100 per cent. But $z = 100$ per cent. $- P$; $y = (100$ per cent. $- P') \div P'$; substituting and simplifying we get $P'v = P - P'$. This formula is clearly the pharmaceutical rule above quoted. Simplifying this we have, $v = (P - P') \div P'$, a simple formula, independent of any volume of alcohol that we choose to take, and easy to keep in mind, in which v represents the multiplier with which to multiply any volume of the alcohol P that we choose to take, to obtain the volumes of water necessary for making alcohol P'. Or we may regard v as representing the number of volumes of water to be added to one volume of P in order to make P'. Thus, if we desire to make 40 per cent. alcohol from 95 per cent. alcohol, $(95 - 40) \div 40 = v = 1\frac{3}{8}$ volumes of water to be added to one volume of 95 per cent. alcohol.

Rule: *To find the number of volumes (v) of water to be added to one volume of alcohol of the grade per cent. (P) on hand, divide the difference between the number (P) denoting the grade per cent. on hand and the number (P') denoting the grade per cent. required by the latter number (P').* Or, which is simpler, $v = (P - P') \div P'$.

E. W. Berger.

Biological Hall,
Ohio State University,
February 22, 1906.

MAGNETISM OF DIAMOND DRILL RODS.

THE fourth report of the Michigan Academy of Science, 1904, contains a short paper by Dr. A. C. Lane on 'Magnetic Phenomena around Deep Borings,' in which attention is called to the magnetism of iron or steel casings in deep wells due to their position in the earth's magnetic field. Cases were referred to in which the magnetism was sufficiently strong to hold large-sized spikes or even heavier wrenches, while difficulty was experienced in lowering heavily weighted steel tapes into the wells, the tape being attracted and held against the side of the casing.

An instance has recently come under my observation in which it appears that diamond drill rods have become quite strongly magnetized because of their position in the earth's magnetic field. While prospecting for bodies of magnetite in a basic hornblende-chlorite schist enclosed on either side by more acid rocks, the drillers found that the drill rods became strongly magnetic. They attributed the phenomenon to the influence of nearby ore bodies, and one mining engineer, in reporting on the property, referred to the observed magnetic effects as a conclusive proof of the proximity of large bodies of magnetite in depth. At the time the magnetism was noticed and reported the drill was cutting through the acid series of rocks, practically free from magnetite. Similar effects were reported from two different borings, but not from other borings near by.

Both of the drill-holes referred to are inclined several degrees from the vertical toward the north, thus approaching parallelism with the lines of force of the earth's magnetic field. As is well known, an iron bar held in this position becomes more strongly magnetic than when held in an east-and-west line. It seemed to me, therefore, that the conditions in the case of the drill rods were especially favorable for the production of strong magnetic effects. According to the reports of several witnesses the drill rods would hold heavy spikes, while the pull on heavier masses of iron was very noticeable. I did not observe the phenomena myself, the holes in question having been abandoned and a new one commenced at the time of my visit.

D. W. JOHNSON.

SPECIAL ARTICLES.

THE TERMINOLOGY OF THE PARTS OF THE GRASS SPIKELET.

PERHAPS in no group of plants has there been more variation in the use of terms than in the use of those employed in botanical descriptions of the grass spikelet. This multiplicity of terms and the resultant confusion have been largely, but not altogether, the result of confused morphology. This has been ably discussed by Bentham and his conclusions, as to both morphology and terminology, have been widely adopted. Of late years there has been more or less tendency to discard Bentham's terms in favor of others. This has led the writer to investigate the whole matter with the end in view of adopting the terminology which best serves the purposes of description.

Using as a starting-point such a spikelet as that of *Bromus* and the terminology of Bentham, we have first the two *empty glumes* at the base of the spikelet. The remainder of the spikelet consists of distichous lateral *florets*. Each floret has a large outer scale or *flowering glume*. Opposite and above this is the two-nerved *palet*. Opposite and above the palet are the two delicate *lodicules*. Still above these are the reproductive organs, the whorl of three stamens and the pistil.

Important modifications from this typical form of spikelet occur as follows:

The empty glumes may be entirely absent, as in *Coleanthus*, solitary as in *Nardus*, mere rudiments as in *Homalocenchrus* and *Zizania*; or the lateral spikelets may each have but one empty glume, while the terminal has two as in *Monerma*. In *Uniola* and the Bambuseæ there are from three to six so-called empty glumes. These are most probably sterile flowering glumes and not proper empty glumes. Such is clearly the case in the so-called third empty glume of the Paniceæ, which often encloses more or less rudimentary sexual organs. It is likewise very common for the terminal florets in the Festuceæ to be reduced to an

empty flowering glume. In *Melica* several such become strangely modified.

The palet is frequently reduced to a rudiment, as in some species of *Agrostis*, or it may be entirely absent, as in other species of the same genus.

The lodicules, two in most grasses, are three in number in many Bambuseæ and altogether wanting in *Alopecurus* and *Anthroxanthum*.

As to the morphology of these organs, it is now generally agreed that the empty glumes and flowering glumes are bracts on the main axis, while the palet is a bractlet on a lateral branch. The lodicules have been supposed to be the vestiges of a perianth.

The empty glumes are variously named by authors. Linnæus and Adanson called them the *calyx;* Jussieu, Kunth and others the *glumæ;* Agardh the *glumæ exteriores;* Link the *glumæ valvæ* or *perigonium externum;* Scheuchzer the *glumæ steriles;* Trinius the *glumæ calycinæ;* Blumenbach the *glumæ vacuæ;* Schleiden the *valvæ glumæ;* Watson the *lower glumes.* With Beauvois they constitute the *tegmen;* with Richard the *lepicena;* with Nash the *empty scales;* with Panzer the *peristachyum;* with Reichenbach the *bracteæ.*

The two empty glumes have been commonly distinguished by the adjectives lower and upper, outer and inner, first and second, or their Latin equivalents. Watson, however, in the 1890 edition of Gray's 'Manual' calls the upper the middle glume when the spikelets are but one-flowered.

The flowering glume and the palet together constitute with Linnæus the *corolla,* or the *valvulæ corolla;* with Trinius the *valvulæ* or *glumæ corolla;* with Jussieu the *calyx;* with Reichenbach the *calyx exterior;* with Beauvois the *stragula;* with Richard and with Link the *glumellæ;* with Malpighi, Schleiden, Lindley and others the *paleæ;* with Agardh the *glumæ interiores;* with Scheuchzer the *folliculi;* with Robert Brown the *perianthium;* with Link the *perigonium internum.* These likewise have been distinguished by the adjectives inferior and superior, exterior and interior, or their equivalents.

With the use of the word flowering glume, the word palea or palet has by almost universal usage been confined to the organ opposite the flowering glume. However, Döll quotes the term *spathella,* said to be used by Turpin.

The lodicules have also come in for their liberal share of names. They are, with Malpighi the *loculi;* with Adanson and most later authors the *lodiculæ;* with Linnæus the *nectaria;* with Jussieu the *squamæ;* with Richard *glumellæ* in common with the flowering glume and the palea; with Agardh the *glumæ intimæ;* with Reichenbach the *calyx interior;* with Schleiden the *squamulæ;* with Link the *periphylla, paropetala* or *perigynium;* with Turpin the *phycostemon;* with Gray in earlier writings the *hypogynous scales;* with Desvaux the *glumellulæ;* with Nees the *perianthium.*

It would seem that with this large mass of terms and multiplied resulting combinations of terms, there is little excuse for introducing a new one. And yet in all this flood of names no one seems to have realized the convenience of having a simple and distinctive name for the organ most used for systematic purposes, the flowering glume. It has been called a valve of the calyx or corolla as the author conceived, or associated with the glumes below it or the palet above it, but never has it received an exclusive designation.

This it seems to the writer is demanded not only by the taxonomic importance of the organ, but as matter of great convenience, incidentally limiting the terms *glumes* strictly to the empty glumes, and obviating any confusion with the palet. In a recent publication I have, therefore, introduced the word lemma (Greek Λέμμα, a husk or scale) for the 'flowering glume.' For the 'empty glume' the simple word glume is adopted. Palet and lodicule are used as heretofore. The so-called third glume of the Paniceæ is a *sterile lemma,* as perhaps are the supernumerary 'empty glumes' in *Uniola* and the Bambuseæ.

C. V. Piper.

Department of Agriculture.

Note on the Molecular Forces in Gelatine.

Some time since, while engaged in a research on fluorescence it became necessary to

know the index of refraction of solid gelatine. As I failed to find the value in any book of constants to which I had access I proceeded to make the determination. I took a 90° totally reflecting prism of flint glass and on the long face dropped a few drops of the purest gelatine I could buy—dissolved in warm water. The liquid gelatine spread out and formed two disks of the gelatine about the size and thickness of silver dimes. I then laid the prism away for the gelatine to dry and harden, expecting to determine its index by determining the critical angle of glass-gelatine. But when I examined the prism a few days later I found it ruined. The gelatine had dried out and contracted, and had clung to the glass with such tenacity that some of the glass had been torn from the remainder of the glass—all the way around the circumference of the gelatine disks, forming an annular cavity from .01 cm. to .1 cm. deep.

This experiment proves, in this instance at least, that the cohesive and contractile forces of gelatine, and the adhesion of gelatine for flint glass are greater than the cohesion of the glass. It proves more, for consider the relatively enormous force that must be exerted to pull a piece, say a disk of glass, from (out of) a large plane-faced block of glass where one must take into account the forces about the edge of the disk as well as those on its faces.

I have lately repeated the experiment, using pieces of window glass instead of the prism. Several times the gelatine disks on drying sprung loose from the glass without injuring the surface. However, on taking extra precautions to have the glass surfaces clean, the gelatine prepared in a clean vessel, and very little water used in dissolving it, patches of glass were pulled off by the gelatine drying and springing up around the edge of the disk.

An unsuccessful attempt was made to measure the tenacity of solid gelatine, unsuccessful because of the difficulty in getting a sample free from internal strain. Further experiments are in progress.

ARTHUR L. FOLEY.

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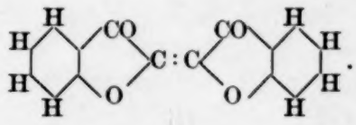
April, 1906.

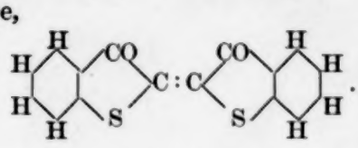
NOTES ON ORGANIC CHEMISTRY.

NEW ANALOGUES OF INDIGO.

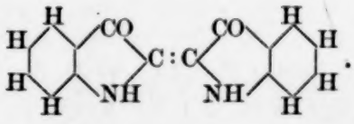
THE importance of indigo in the arts is so great that considerable general interest attends the discovery of related compounds. Some years ago P. Friedländer and J. Neudoerfer[1] prepared a compound which they believed to be represented by the formula,



Friedländer has now confirmed this result[2] and has also obtained the corresponding thio-derivative,



On comparing these formulæ with that of indigo,



it will be observed that the two new compounds are to be regarded as indigo in which the bivalent imino (NH) group is replaced by an equivalent atom of oxygen and sulphur, respectively.

Oxygen-indigo, as the first compound may be termed, is a red dye which is much more rapidly acted on by light than indigo. Its preparation is attended with considerable difficulty.

Thioindigo, on the other hand, can be obtained with comparative ease from thiosalicylic acid. It also is a red, sparingly soluble dye, crystallizing in brown-red needles with a bronze luster. Its chloroform solution is red, with a shade of blue, and it exhibits a strong yellowish-red fluorescence and a characteristic absorption spectrum. At high temperatures thioindigo is more stable than indigo and may be sublimed and distilled. Thioindigo resembles indigo in its behavior with acids, re-

[1] *Ber. d. Chem. Ges.*, **32**, 1867 (1899).
[2] *Ibid.*, **39**, 1060 (1906).

ducing and oxidizing agents, but goods dyed with it surpass those dyed with indigo in their stability to light and resistance to oxidation. It is, as yet, uncertain whether thioindigo will have any technical value.

J. Bishop Tingle.

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RECENT MUSEUM REPORTS.

In reading the *Report of the U. S. National Museum* for 1903–1904 one is struck with the liberality displayed in permitting the use of material and in publishing the results of the labors of others than its regular staff. The bibliography of papers based in whole, or in part, on its collections contains some eighty names. Much is done for the public at large in the way of furnishing information and identifying specimens. Perhaps these may be among the causes that have delayed the publication of the report for something over a year and a half, although the report proper was issued as a separate in 1905. Owing to this delay we have an account of the commencement of work on the new museum building when the basement story is now largely built. In view of the cramped quarters occupied at present and the need of extensive repairs to the roof of the old museum building it is to be hoped that work may progress rapidly. Among the more important accessions noted are ethnological and zoological collections from the Malay Archipelago and Philippines, obtained by Dr. W. L. Abbott and Dr. E. A. Mearns. The most extensive additions are in the departments of botany and entomology, the rapid growth of the latter department during the past few years making the collection of insects one of the most important in the world; the collection of musical instruments is also in the foremost rank. This in spite of the fact that the museum has always been sadly hampered in obtaining desirable specimens by the small appropriation—$10,000—for their purchase. Even this paltry sum (paltry for a national institution) less than some museums pay for a single object, was struck out of the appropriation for 1905.

Attention is called to the smallness of the museum staff in comparison with the work required of them, and it may also be said that this is all the greater owing to the comprehensive scope of the museum collections. There are those who believe that this is greater than any one museum can justly cover, and consider that a readjustment of the collections to form at least three separate museums would be advantageous and result in better support by congress.

As usual the report includes papers based on the collections or work of the museum. This year there are only three such articles, but one, 'Contributions to the History of American Geology,' by George P. Merrill, is a book in itself, giving a consecutive history of the rise and progress of geology in this country from 1785 to 1879. Furthermore, there are chapters on the 'Fossil Footprints of the Connecticut Valley,' 'The Eozoon Question,' 'The Laramie Question' and 'The Taconic Question.' There are portraits of many, if not most, of the well-known geologists of the United States, the whole forming a most important, much-needed, and, withal, readable work.

The Annual Report of the Director of the Field Columbian Museum for 1904–1905 marks the steady progress of this institution, not the least important event being the consideration of the plans for a new building. It is to be earnestly hoped that this may be commenced without further delay to furnish proper housing for the collections.

Important accessions are noted, especially by purchase, this being a most satisfactory way in which to acquire specimens since only those are obtained that are needed; many minerals, botanical and ethnological objects were secured in this way. No less than thirteen field parties were sent out during the year, the expedition to the Bahamas resulting in many additions to the herbarium, while the department of geology secured important material from the White River Beds, including skulls of *Brontops, Hyracodon, Aceratherium* and various creodonts. From the results of collecting in former years one fine skull of *Triceratops* has been prepared and placed on exhibition and another partially worked out.

Considerable attention has been paid to the local fauna and important additions made to the series of nestlings; other work has been the preparation of series of skins to illustrate the progress of moult from beginning to end.

In ethnology three halls, devoted to material from the northwest coast, have been opened and two others are in course of preparation.

The report is illustrated by a number of excellent plates. F. A. L.

REPORT ON THE BOLYAI PRIZE.

HAVING just received from its author, G. Rados, of Budapest, the detailed report of the Commission on the Bolyai Prize to the Hungarian Academy of Sciences, I venture to translate a few excerpts.

On the occasion of the hundredth anniversary of the birth of John Bolyai was established in honor of this marvelous genius a prize of ten thousand crowns, to go every five years to the author of the best work in mathematics published during that lustrum, account being taken of the entire productivity of the winner. The first decision is as follows: The committee states first that the new view-points dominating modern mathematical investigation have brought out a very notable number of mathematical works whose high worth the committee gladly recognizes; but just this circumstance has made the committee's problem of exceeding difficulty.

The committee was convinced it should best fulfil the intention of the academy by deciding only to consider those works having the most important influence upon the *general* development of mathematics. In this spirit the committee could limit itself to the consideration of the works of two investigators whose merits are acknowledged on all hands, *David Hilbert* and *Henri Poincaré*.

The committee now has reached the unanimous decision to give the Bolyai prize to Henri Poincaré, taking into consideration, in the sense of the statutes, all his work, beginning in 1879 and now having completed a cycle of the entire domain of mathematics, opening everywhere to mathematical investigation new points of view. The committee has, however, at the same time decided, in order to give Professor Hilbert a very special mark of their high appreciation, to charge their reporter—contrary to the usual custom—to discuss Professor Hilbert's works with the same detail as those of Professor Poincaré. For their universal significance is in full measure prized and the committee is convinced they are called to a rôle of ever greater importance.

Professor Rados now begins his report by saying Henri Poincaré is at the present moment unquestionably the most powerful investigator in the domain of mathematics and mathematical physics. His strongly marked individuality lets us recognize in him the intuitive genius drawing the inspiration for his wide-reaching researches from the exhaustless fountain of geometric and physical intuition, yet capable also of working this out in detail with marvelous logical keenness. With his brilliant inventive genius he is distinguished by the capacity for sharp and successful generalization of mathematical relations, which oft empowers him to push far out the boundaries of knowledge in the most widely different domains of pure and applied mathematics. This is shown even in his first memoirs on automorphic functions, with which he begins the series of those brilliant publications, which must be reckoned with the greatest mathematical achievements of all time. Rados plunges now into detail, finishing a necessarily fragmentary account of Poincaré's more than 300 publications, with a mention of his books, of which we will only name two, 'Science and Hypothesis' (1902) and 'The Value of Science' (1905).

Finally, he says, permit me to make mention of his last book, 'The Value of Science' (1905), in which he in a way has laid down the scientist's creed.

I wish from this intensely interesting book to quote a bit verbatim where he carries out in detail the contrast between the intuitional and the logical way of thinking. In regard to the logicians, then says Poincaré:

> Rejecting the aid of the imagination, which, as we have seen, is not always infallible, they can advance without fear of deceiving themselves. Happy, therefore, are those who can do without

this aid! We must admire them; but how rare they are!

Of these marvelous and rare ones is David Hilbert, the master of logical analysis in mathematics. Gifted with brilliant logical power of combination, he creates from out his very self, entirely by generalization, by separation, by union, by aggregation of mathematical concepts, so that no outer stimulus, dependent upon intuition, is recognizable. Logical rigor and elegance of demonstration are for him adequate requirements, and he is convinced that logical precision—rightly grasped—must lead, never to sterilization, but constantly to fruitful further development of mathematical ideas. He applies himself by preference in his investigations to the most difficult, long-unsettled problems, whose essence he with marvelous penetration is able so to seize, that his considerations not only completely solve these problems, but often bring to a final settlement also the whole theory to which these problems pertain.

Mention is then made, among many other achievements, of the wonderful 'Grundlagen der Geometrie' which seems destined to fix what men shall henceforth take as the axioms of geometry, and to establish the criterion of what shall be and shall not be elementary demonstrative geometry.

All hail! Poincaré the supreme mathematician, Hilbert the supreme logician, philosophers, scientists both!

George Bruce Halsted.

Kenyon College,
Gambier, Ohio.

THE CONGRESS OF THE UNITED STATES.

May 7.—Under a suspension of the rules, House Resolution 18,435 to authorize the Secretary of Commerce and Labor to cooperate through the Bureau of the Coast and Geodetic Survey and the Bureau of Fisheries with the Shell Fish Commissioners of the State of Maryland in making surveys of the natural oyster beds, bars and rocks in the waters within the State of Maryland passed the House of Representatives.

May 7.—Under a suspension of the rules, House Resolution 13,543 for the protection and regulation of the fisheries of Alaska, with amendments, passed the House of Representatives.

May 10.—Mr. Perkins, of California, introduced a bill (Senate 6,119) for the protection of animals, birds and fish in forest reserves of California. Referred to the Committee on Forest Reservations and the Protection of Game.

A NEW BUILDING FOR THE GEOLOGICAL SURVEY.

The need of the United States Geological Survey for a new building in Washington, D. C., is most pressing, as every one who visits the survey in its present quarters must realize.

This bureau gives permanent employment to about 1,000 persons, and temporary field employment, chiefly in summer, to nearly as many more. Of this force about 600 are engaged at times, and during all of every winter, on office work in Washington. For their accommodation two buildings are at present rented, one at 1330 F Street, N. W., for general office work, and one in the adjoining alley for the exclusive use of the division of engraving and printing. The floor space occupied, including basement, amounts to 105,670 square feet, which is quite inadequate. Even the corridors have to be utilized for desk space or map cases. It is necessary to supply quarters for some employees in the National Museum and Smithsonian Institution and others are permitted for lack of proper office accommodations to work at home.

A large part of the survey office work is of such character as to demand much more space than that sufficient merely for the desks and chairs of employees. Chemists, physicists, photographers, petrographers, draftsmen, engravers, lithographers and other specialists must have room for their instruments, apparatus, maps, working specimens, drawings, lithographic stones, presses, etc. There is no doubt but that the degree of crowding to which the office force is now subjected diminishes the quantity and depreciates the quality of their work.

Even though the buildings now occupied by the survey were sufficiently commodious, they

could never be made suitable for the purposes of the bureau. The delicate physical apparatus is constantly affected by vibrations from the heavy printing presses. At least twenty-five rooms in the main building are so dark that it is impossible to work in them without the aid of artificial light. In the darkest of these rooms forty-five persons are working from 9 in the morning until 4:30 in the afternoon by the help of electric light. Unless they are soon provided with better-lighted rooms their vision will be permanently impaired and their capacity for work correspondingly decreased.

Not the least important reason for housing the survey in a modern, fire-proof building of its own is the consideration that government property and records valued at approximately $6,000,000 are in constant danger of loss by fire. Recently, over $10,000 worth of property was destroyed in twenty minutes by a fire in the photographic laboratory on the top floor of the main building. The buildings contain over 100,000 square feet of varnished and inflammable wooden partitions, along which fire could spread with great rapidity. Many of the records thus flimsily sheltered could not be replaced at any price.

What the survey needs is a strong, fire-proof, well-lighted building containing a net available space of at least 150,000 square feet, exclusive of basement and halls. Such a building would cost about $1,200,000. The annual rent paid on the buildings now occupied is $34,900, which is nearly three per cent. on $1,200,000.

A bill for such a structure as is required was introduced in the senate by Mr. Frank P. Flint, of California, on March 21 and in the house of representatives by Mr. James S. Sherman, of New York, on March 26.

UNIVERSITY OF THE PACIFIC AND THE EARTHQUAKE.

THE University of the Pacific, San Jose, California, the oldest institution of higher learning on the Pacific coast, was damaged to the extent of about $60,000, net, during the recent earthquake. East Hall, a large four-story brick building, the only building on the campus seriously damaged, will be lowered to two stories. The fourteen rooms on the ground floor are occupied by laboratories. Two thousand dollars had just been put into additional equipment; but the entire loss of apparatus, chemicals, etc., will not amount to more than $500. The Monday following the earthquake the laboratories were running as usual, as were the other departments of the university. The other buildings on the campus were not damaged except in the loss of plaster. The executive committee has decided to erect a two-story 'earthquake-proof' building to take the place of the upper half of East Hall. The Jacks-Goodall observatory on the southwest corner of the campus was not injured. Seven buildings owned by the university in San Francisco were entirely lost; but they will be rebuilt at once. The residence of President McClish was destroyed, but it will be rebuilt. Among the professors, the residences of Dr. Hatzell and Dr. Sawyer were the only ones damaged, and those but slightly. No lives were lost, but two students were injured by falling bricks.

NEW YORK OBSERVATORY AND NAUTICAL MUSEUM.

PRELIMINARY plans have just been formulated for the organization of a great marine museum for the city of New York. It is expected that this will mean to the navigator what the Metropolitan Museum means to the lover of art and the American Museum to the student of natural history. The new institution will take its place as one of the three great museums of the city of New York, and in it one can study the tides, navigation and marine instruments at first hand.

As the science of navigation is based on astronomy, it will be necessary to have an astronomical observatory as an adjunct to it. The capitals of Europe, London, Paris and Berlin, each has its magnificent observatory; and in the United States the cities of Washington, Boston, Chicago, San Francisco and Pittsburg, have their big telescopes and finely equipped observatories. The commercial capital of the United States, the second largest city in the

world, has done very little for astronomy, and it is with profound satisfaction we learn that commerce and navigation, on which the supremacy of New York largely depends, is to be aided by the founding of the 'New York Observatory and Nautical Museum.'

This institution will consist of two distinct departments:

1. *A Nautical Museum,* where will be collected and exhibited models of all types of vessels, safety and signal devices, nautical instruments and methods of determining position, charts, marine engines and motors, and historic instruments and relics. The museum and collections will be open to the public and will be arranged so that properly qualified persons can avail themselves of the facilities there offered for investigation and research.

2. *An Astronomical Observatory,* where will be made scientific investigations in the field of astronomy, navigation and kindred subjects, and for this purpose the observatory will be provided with a great telescope, for photographic and visual work, astrophysical instruments for the investigations of interesting problems of the sun, magnetometers, seismographs, etc. A time service will be instituted so that chronometers may be rated, all kinds of marine instruments will be tested, and tidal investigations will be taken up.

The institution is to have an endowment of not less than $500,000, and in addition to this it is expected that the city of New York will provide a site in Bronx Park adjacent to the Botanical Garden and Zoological Park, and will also erect the museum building and the domes and smaller buildings for the observatory.

The organization committee consists of such well-known New Yorkers as Frederick G. Bourne, Cornelius Vanderbilt, Edward S. Isham, George A. Cormack, J. D. Jerrold Kelley and Charles Lane Poor, and their backing means success. Dr. Poor, professor of astronomy at Columbia University, has made an enviable record for himself through his cometary researches, and by his recent discovery that the sun is a vibrating body continually changing its shape. Further researches carried out through a series of years will probably make clear the meaning of this change; and this will go a long way towards solving some of the outstanding problems of astronomy.

There is every reason to believe that the new observatory will be founded and will at once take its place among the great observatories of the world.

BILLS OF SCIENTIFIC INTEREST PASSED BY THE NEW YORK LEGISLATURE.

The New York legislature has passed a bill providing for a new building for the State Museum, State Library and the Education Department, to cost not more than four million dollars. The bill carries an appropriation for the acquisition of a site and the preparing of plans. For these plans twenty thousand dollars in prizes are to be awarded to the first, second and third choice of plans submitted to the commission having the erection of the building in charge.

The legislature also passed a bill to acquire Watkins Glen, one of the many ravines running into the Finger Lakes of western New York, for a state reservation.

The following legislation was passed in regard to the protection of Niagara Falls: Four inactive charters were repealed, leaving four others still outstanding, two of which are actively engaged in diverting water. The legislature also passed the Foelker bill to prevent any abstraction of water beyond the present chartered limits of abstraction.

A referendum for a constitutional amendment to permit the flooding of parts of the state reservation in the Adirondacks for the manufacture of power by private corporations was also passed.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The work of the local committee in arranging for the Ithaca meeting is approaching completion. In addition to the usual sessions for the reading of papers the program will include the following events:

Thursday evening, June 28, an informal smoker at the Town and Gown Club.

Friday evening, June 29, formal opening of the new Physical Laboratory, Rockefeller Hall, with short addresses by several well-known speakers.

Saturday, June 30, special local excursions will be arranged for botanists, geologists, zoologists, entomologists, chemists, etc., also an excursion to the George Junior Republic and trips to local points of scenic interest. It is probable that a trip to Niagara Falls, returning Sunday evening, will be arranged.

Monday evening, July 2, public meeting under the auspices of the local chapter of Sigma Xi in celebration of the twentieth anniversary of the founding of the society, with an address by some eminent man of science.

The permanent secretary has arranged for a special railroad rate of one and one third fares plus twenty-five cents on the certificate plan, and other passenger associations are expected to cooperate. Tickets may be obtained not earlier than June 25 and not later than June 30 and will be good for the return journey up to July 6.

The preliminary program will be sent out about June 1.

SCIENTIFIC NOTES AND NEWS.

THE University of Edinburgh has conferred its doctorate of laws on Professor A. Graham Bell, who was born in Edinburgh in 1847.

DR. MORRIS K. JESUP, president of the American Museum of Natural History, New York, has been elected a corresponding member of the Frankfort Society of Natural History.

DR. J. H. FINLEY, president of the College of the City of New York, has been elected president of the American Social Science Association.

WE are glad to learn that Mr. William T. Hornaday, director of the New York Zoological Park, who has been seriously ill from actinomycosis, supposed to have been contracted from a chimpanzee, is in an improved condition after an operation.

DR. JOHN K. REES, professor of geodesy and astronomy in Columbia University and director of the observatory, has been made professor emeritus. We regret that his retirement from active work is due to continued illness following a stroke of apoplexy.

DR. L. O. HOWARD, chief of the Division of Entomology, U. S. Department of Agriculture, and permanent secretary of the American Association for the Advancement of Science, expected to return on the *Oceanic*, which was due in New York on the sixteenth.

AMONG the members of the U. S. Geological Survey in the neighborhood of San Francisco at the time of the recent earthquake was Mr. G. K. Gilbert, geologist, who has been engaged for several months in making hydraulic experiments in the mining laboratory of the University of California at Berkeley. Instructions were telegraphed him immediately to make as thorough a study as possible of the earthquake phenomena.

MR. F. H. NEWELL, chief engineer of the U. S. Reclamation Service, has recently returned from an inspection of the works under construction in the territories of Oklahoma, New Mexico and Arizona, and in the states of California, Nevada, Utah, Colorado and Kansas. Rapid progress is being made on construction. The work in its general magnitude now stands well toward the front of public undertakings. The expenditures on water storage and distribution systems aggregate about $1,000,000 a month. Most of the large engineering problems have been worked out. The present rate of construction and expenditure is probably at the maximum and will decrease gradually, many of the most expensive structures being now at the period of greatest activity. During his absence in the west Mr. Newell has been elected a member of the corporation of the Massachusetts Institute of Technology, of which he is a graduate; also a member of the board of trustees of the Washington (D. C.) College of Engineering of the George Washington University. He has also been elected as one of the board of directors of the Washington Society of Engineers and chairman of the committee on meetings.

DR. JULIUS WIESNER, professor of the physiology and anatomy of plants in the University of Vienna, has been made a life member of

the upper house of the Austrian parliament.

At the annual general meeting of the Institution of Civil Engineers, held on April 24, Sir Alexander B. W. Kennedy, F.R.S., was elected president of the institution.

The Iron and Steel Institute of Great Britain awarded last week its Bessemer gold medal to M. Floris Osmond, of Paris. One of its Andrew Carnegie research scholarships was awarded to Mr. F. Hess, of Columbia University, but he was unable to accept.

At the University of Colorado the annual Sigma Xi address was given by Professor Thomas H. MacBride, of the State University of Iowa. The subject was 'The American Deserts.'

Professor W. Nernst, of Berlin, whose appointment as Silliman lecturer at Yale University we have announced, will lecture in October on applications of thermodynamics in chemistry.

George H. Chadwick, of Rochester, has been appointed zoologist of the New York State Museum, to fill the vacancy left by the death of Dr. F. C. Paulmier.

Henry H. Goddard, Ph.D. (Clark), of the department of psychology and pedagogy at the State Normal School, Chester, Pa., has been given charge of a department of research which has been established in the New Jersey Training School for Feeble-minded Girls and Boys at Vineland. This, we understand, is the first department of the kind that has been established in connection with a school for feeble-minded children.

A bronze bust of the late Dr. Alexander J. C. Skene was unveiled near Prospect Park, Brooklyn, on May 5, when an address was made by Dr. A. Jacobi.

Dr. Georges Brélaz, professor of chemistry in the University of Lausanne, died on March 15, at the age of seventy-five years. The death is also announced of Dr. Gustav Bauer, professor of mathematics at Munich.

There will be U. S. Civil Service examinations on June 1 to fill the position of agriculturist in dry-land agriculture in the Bureau of Animal Industry, at a salary of $2,750, and of assistant agriculturist in the same bureau, at a salary of $1,000.

Mr. Robert Y. Cummings has given $20,000 to the Field Museum of Natural History to defray the expenses of an ethnological study of the native tribes of the Philippine Islands.

The cornerstone of the United Engineering Building on West Thirty-ninth Street, New York, was laid on May 8 by Mr. Andrew Carnegie, who gave one and a half million dollars for its erection to the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers. The building is already in course of erection, being about half finished.

The sixth International Congress of Applied Chemistry was opened at Rome on April 26 by the king and queen of Italy in the presence of the diplomatic body, the members of the cabinet, high officials of the state and about two thousand delegates.

The first of the annual conversaziones at the Royal Society was held on May 9.

The German government has issued invitations for an International Conference on Wireless Telegraphy to meet on June 28.

A local section of the American Chemical Society has been organized at the University of Illinois, Urbana, Ill. It embraces the territory within a radius of fifty miles from the university. The following officers have been elected:

Presiding Officer—Professor S. W. Parr.
Vice-chairman and Councilor—Dr. H. S. Grindley.
Treasurer—Dr. A. T. Lincoln.
Secretary—Dr. R. S. Curtiss.

The above officers were also chosen members of a general committee. The charter members number twenty-six, of whom all but three are resident at the University of Illinois.

We learn from *Nature* that the International Association for Testing Materials, which holds its congresses about every three years in industrial centers in various countries, will this year meet in the Academy of Science at Brussels on September 3–8. The

king of Belgium has accorded the congress his patronage, while Prince Albert of Belgium will be one of the honorary presidents, as also will the ministers of finance, railways, war and trade, and the mayor of Brussels. Among the papers to be read will be one on the industries of Belgium, by Baron E. de Laveleve and M. Camerman.

THE Maryland Geological Survey has established a permanent State Mineral Exhibit in the old House of Representatives at Annapolis. The materials forming this exhibit have been gradually collected by the survey during the last few years, the nucleus being the Maryland mineral exhibit at Buffalo in 1901. This was materially added to in the preparation of the state's exhibit at Charleston the following winter and was still further increased for the Maryland exhibit for the Louisiana Purchase Exposition at St. Louis in 1904. The latter display has again been much enlarged for the present purpose and is intended to thoroughly illustrate the mineral resources and industries of the state. The exhibit was opened the first of April at the time of the session of the legislature.

THE atlas published by the U. S. Geological Survey to accompany Monograph 32 on the Geology of the Yellowstone National Park is now available. Bound in paper the atlas costs $2.80, in cloth $3.75, in sheepskin $4.25. Whether his taste in bindings inclines by nature to the esthetic or by necessity to the utilitarian, the scientist may now have maps of the Yellowstone. The monograph, which the atlas is destined to accompany, is several years older, but costs less. It first saw the light in 1899, and it sells for $2.45. Only the second volume, however, is published. Dr. Arnold Hague and his assistants had previously brought out, in 1896, a geologic folio relating to the Yellowstone National Park, which has the distinction of being the only geologic folio that ever sold for 75 cents. The atlas contains six topographic maps, which cover the area of the Yellowstone National Park and a large portion of the Yellowstone Forest Reserve. The Yellowstone National Park is situated in the northwest corner of the state of Wyoming, but a narrow strip, about two miles in width, along the west side extends into Montana and Idaho, and the northern boundary lies in Montana, two miles north of the Wyoming state line. The scale of these sheets is nearly two miles to the inch. A combined map of the six large topographic sheets is also published as one double-page map. Six geologic maps of the same areas covered by the topographic work are included in the atlas. The six geologic sheets are also combined to form a double-page map, which shows the areal geology of the Yellowstone National Park and a portion of the Yellowstone Forest Reserve. In the reserve is included the greater part of the Absaroka Range, a feature essential to the correct understanding of the geology of the park. To the tourist this atlas will make a special appeal, as it makes available for the first time reliable maps of the various geyser basins in the park. The fact that these interesting natural phenomena have been mapped will have a tendency to reduce the number of names indiscriminately and confusingly applied to them by guides, visitors and students, and to secure the general adoption of the place names used on the maps. The corps of assistants that aided Dr. Hague in the interpretation of this great area included Messrs. Joseph Paxson Iddings, Walter Harvey Weed, George M. Wright and T. A. Jaggar, Jr.

WE learn from the London *Times* that a resolution has been adopted by the council of the Royal Scottish Geographical Society and ordered to be submitted to the Secretary of State for India in Council. It is to the effect that, in view of the great regret felt in geographical circles throughout the world that the proposed expedition down the Brahmaputra to Assam did not take place at the close of the Tibet mission, 1903–4, the council trust that the Indian government will now see their way to carrying out this exploration, which is of extreme interest and importance, on the following grounds: By it would be finally settled the question of the connection of the Sang-po of Tibet with the Dibong (Brahmaputra) of Assam. The known difference of

levels renders it certain that the river must descend from Tibet to the plains of India by great waterfalls exceeding all others in height and volume. If these falls (which are said by the Tibetans to exist) should be discovered, much light would be thrown on the geology of the region. In particular we might expect information as to the structure of the country traversed, and the relation borne by the vast Himalaya ranges to the elevated plateau against which they abut. Nothing is known at present of the tribes who inhabit the tract through which this part of the river passes. Valuable collections of fauna and flora would probably be obtained. It is possible that a good route might be discovered leading from Assam into Tibet by the great river; such a route would have much importance in promoting British trade with Tibet. The resolution is signed by the president, Professor James Geikie.

UNIVERSITY AND EDUCATIONAL NEWS.

It is reported that the University of California will lose $60,000 yearly by the destruction of buildings owned by it in San Francisco, and that it will lose a further sum of $50,000 yearly by the reduction in value of assessable property in the state. We may hope, however, that the loss of income on the San Francisco property is only temporary, and that the state will not permit the university to suffer from the decrease in the taxes.

Columbia University has received $5,000 for a mathematical prize, in memory of John D. Van Buren, Jr., a member of the class of '03, given by Mrs. Louise T. Hoyt. Mr. Edward S. Harkness gave $2,700 to the morphological museum at the College of Physicians and Surgeons, and Mr. Archer M. Huntington gave $1,000 to support a lectureship in geography.

On April 3, 1905, Mr. Andrew Carnegie offered Morningside College, Sioux City, Iowa, $50,000 on condition that they raise $150,000. On April 3, 1906, his conditions for the gift were satisfied, and a couple of weeks later Mr. Carnegie's check was received. This adds $200,000 of productive endowment to the resources of the college. Mr. Carnegie has also given the sum of $50,000 to Drury College, at Springfield, Missouri, on condition that the college increase its resources by the sum of $200,000. About one third of this required sum has been raised since January 1.

Indiana University has been unable to provide the library and laboratory equipment necessary to secure the two endowments for pathological research, recently offered it by a Chicago physician and by Dr. Benjamin Taylor Terry, of New York City. The combined value of the two gifts thus lost to the university is $20,000.

The senior class of the Colorado School of Mines is now on its annual trip of inspection. The itinerary is much more extensive than that of previous years, requiring a month for its completion and covering the important mining and metallurgical sections of Colorado, Utah and Montana. The students have been received everywhere with marked courtesies and are finding the trip a valuable climax to their four years of study. Five instructors accompany the party.

Dr. Franklin H. Giddings, professor of sociology in Columbia University, has been appointed professor of the history of civilization, filling the chair founded recently by Mrs. Maria H. Williamson with a fund of $150,000. Professor Harold Jacoby has been made administrative head of the department of astronomy and director of the observatory.

Professor William Turner, professor of philosophy in St. Paul's Seminary, St. Paul, Minnesota, and the author of a 'History of Philosophy,' has been called to a professorship of philosophy in the Catholic University at Washington.

Dr. W. K. Hatt has been promoted to the professorship of civil engineering in Purdue University.

According to a press despatch, the council of the Faculty of Sciences has confirmed the initiative of the minister of public instruction in appointing Mme. Curie to the chair of the University of Paris occupied by the late M. Curie.